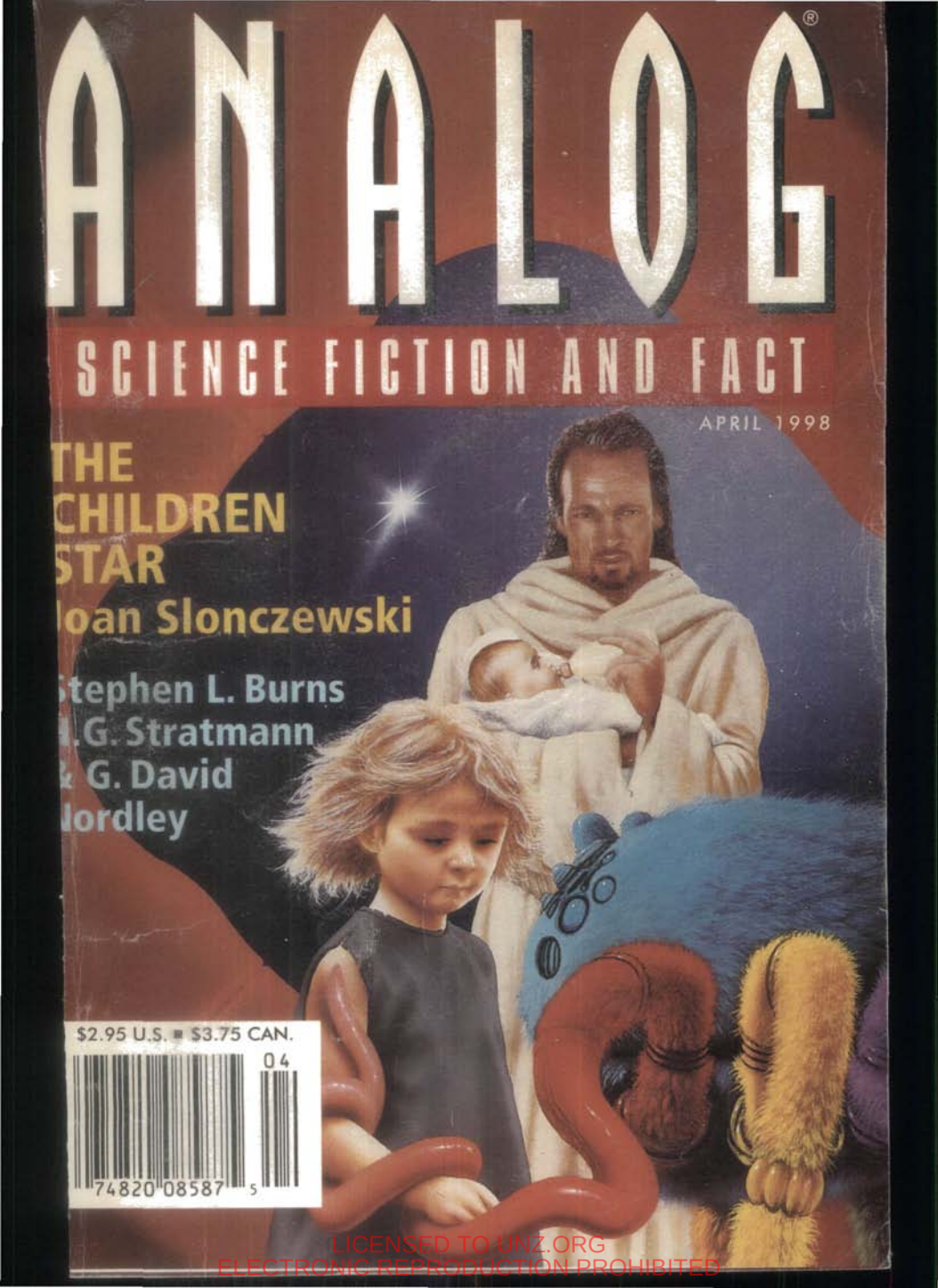
ANALOG®

SCIENCE FICTION AND FACT

APRIL 1998

THE
CHILDREN
STAR
oan Slonczewski

tephen L. Burns
.G. Stratmann
& G. David
lordley



$2.95 U.S. ■ $3.75 CAN.

04

74820 08587 5

LICENSED TO UNZ.ORG
ELECTRONIC REPRODUCTION PROHIBITED

RETURN TO I
FOUNDATI

THE NEW HARDCOVER, IN THE SECOND FOUNDATION TRILOGY, AUTHORIZED BY THE ASIMOV ESTATE.

RAVE REVIEWS FOR THE FIRST BOOK IN THE SERIES:

"An excellent work."
—*Washington Post*

"He brings out the complexities of a galactic emp
that Asimov never filled out."
—*Denver Post*

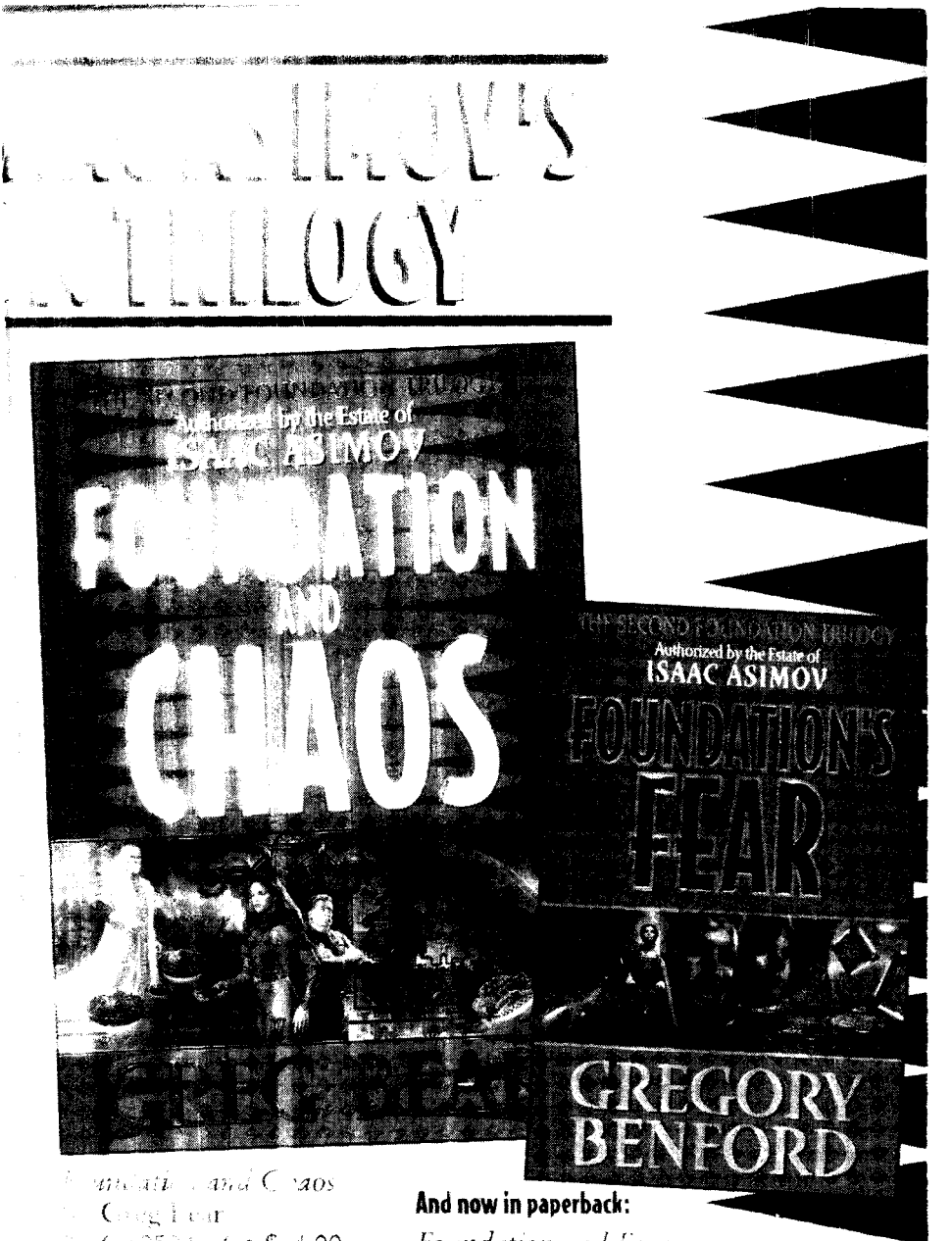
"For the legions of readers who have
long been tantalized by Asimov's cryptic referen
to psychohistory, Mr. Benford provides some
fascinating insights into its development."
—*New York Times*

"A richly rewarding delight."
—*Publishers Weekly*

HarperPrism
A Division of HarperCollinsPublishers
http://www.harperprism.com

AVAILABLE AT YOUR LOCAL BOOKSTORE

LICENSED TO UNZ.ORG
ELECTRONIC REPRODUCTION PROHIBITED



Foundation and Chaos
Greg Bear
0-06-105252-6 • $ 4.00

And now in paperback:
Foundation and Fear
by Gregory Benford
0-06-105638-3 • $6.99

LICENSED TO UNZ.ORG
ELECTRONIC REPRODUCTION PROHIBITED

ANALOG
SCIENCE FICTION AND FACT

Vol. CXVIII No. 4
April 1998

Next Issue on Sale
April 7, 1998

Serial
THE CHILDREN STAR (Part One of Four),
Joan Slonczewski ____ 10

Novella
THE COVERTURE INCIDENT, Stephen L. Burns ____ 76

Novelettes
THE VIGILANT ONES, Alexis Glynn Latner ____ 116

Science Fact
BIOLOGICAL HAZARDS AND MEDICAL CARE IN SPACE,
H.G. Stratmann and G. David Nordley ____ 60

Short Stories
SHRINK WRAPPED, David Alexander ____ 140

Probability Zero
IT'S THE THOUGHT THAT COUNTS, Ian Randal Strock ____ 145

Reader's Departments
THE EDITOR'S PAGE ____ 4
IN TIMES TO COME ____ 134
THE ALTERNATE VIEW, John G. Cramer ____ 135
THE REFERENCE LIBRARY, Tom Easton ____ 146
BRASS TACKS ____ 153
UPCOMING EVENTS, Anthony Lewis ____ 160

Cover design by Victoria Green

Cover art by Jim Burns

Stanley Schmidt
Editor

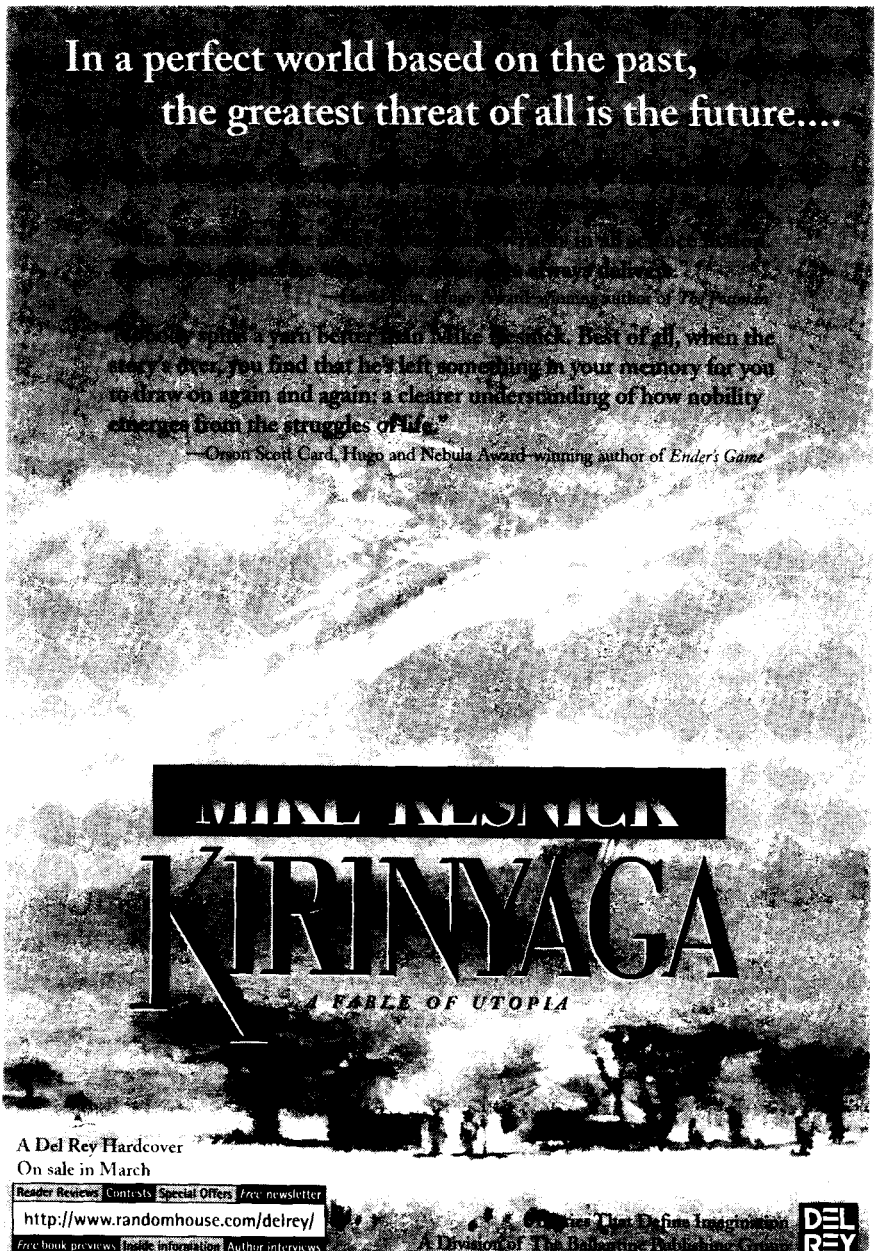
Daniel Imal
Assistant Editor

Peter Kanter
Publisher

Christine Begley
Associate Publisher

Indicia on Page 5

LICENSED TO UNZ.ORG
ELECTRONIC REPRODUCTION PROHIBITED


In a perfect world based on the past,
the greatest threat of all is the future....
spins a yarn better than Mike Resnick. Best of all, when the
story's over, you find that he's left something in your memory for you
to draw on again and again: a clearer understanding of how nobility
emerges from the struggles of life."
—Orson Scott Card, Hugo and Nebula Award–winning author of Ender's Game
MIKE RESNICK
KRINYAGA
A FABLE OF UTOPIA
A Del Rey Hardcover
On sale in March
Reader Reviews Contests Special Offers Free newsletter
http://www.randomhouse.com/delrey/
Free book previews Inside information Author interviews
A Division of The Ballantine Publishing Group
DEL REY

LICENSED TO UNZ.ORG
ELECTRONIC REPRODUCTION PROHIBITED

EDITORIAL Stanley Schmidt

SECRET WEAPONS

Recently we've been hearing quite a bit about the growing danger from new strains of old diseases that have become resistant to antibiotics. To combat the threat, various groups such as the US Centers for Disease Control and Prevention (CDCP) have begun a campaign, aimed at both doctors and patients, to reduce the casual overuse of antibiotics.

It's a hard idea to sell to many laymen, who understandably don't like to be sick and have become used to having antibiotics able to dispel a wide range of demons on demand. Some doctors have gone along with this, prescribing antibiotics to patients who want them even for things against which they're useless, like colds and other viral infections. Why? Patients wanted them; it was a lot of trouble to explain to them why they wouldn't really help; and it seemed, at least to most people until recently, that while the antibiotics weren't likely to do any real good, neither were they likely to do any harm. It has now become apparent that unnecessary use *can* do harm, by encouraging the evolution of resistant strains; but that's quite a subtle concept to get across.

How, patients ask, can giving something that *might* combat disease, even if the odds aren't very good, be harmful—especially if that something will not itself hurt the patient? At first, groups like the CDCP tried to explain in rather abstract terms, and found that the effort had little effect on antibiotic abuse. "Our big mistake," according to Michael Marcy of Kaiser Permanente California Healthcare Program, quoted in a *Wall Street Journal* article, "was telling people they were screwing up the globe. Now we're saying you're harming yourself and you're harming your child."

So far, so good. People are far more likely to respond to something that they perceive as a *personal* problem than to a purely abstract threat to the world as a whole, which seems too vague and distant to get excited about. So trying to make them see the overuse and consequent reduced effectiveness of antibiotics as affecting them *personally* is a step in the right direction. But there remains the problem of making them *believe* it's a personal threat, and that requires explaining *why* in a way that they'll understand.

There is an analogy that seems to me quite obvious and likely to do the job for many people; yet as I write this, I can't recall seeing it in any of

LICENSED TO UNZ.ORG
ELECTRONIC REPRODUCTION PROHIBITED

the many articles I've read on this subject. It's not perfect, of course; analogies never are. I'm also a little reluctant to use it because it involves thinking of the problem in military terms, and most people are far too quick to look for military-type solutions when something else might be feasible and better. But I think this analogy does have considerable validity and is vivid and clear enough that many people could easily grasp it. And this may be one case in which there *aren't* better alternatives to the "military" approach. I haven't heard of anyone who knows how to negotiate with germs.

So here goes . . .

Everybody has read stories and seen movies with plots involving a country that is embroiled in war and has developed a new weapon. It's generally taken for granted that that country will want to keep that weapon and its workings secret from the enemy. This obviously involves keeping the plans under wraps, lest the enemy build the weapon and use it against the inventor. But it also means not *using* the weapon indiscriminately. The more it's used, the more chance the enemy will have to see what it does and, if not copy it, at least develop defenses against it. It's better to keep it out of sight until you see an opportunity to do something strategically potent with it. Rather than using it immediately and often, you'll do better to use it in a few crucial, carefully selected battles where it will have maximal effect. That way you have a chance to win the war while keeping your secret—in case you need it again later.

The age-old struggle to control infectious disease is, in a very real sense, a war between our species and many others. We have built-in defenses that work with varying degrees of effectiveness against many of them; but when one of them gets too powerful, antibiotics serve as a "secret weapon." But the enemy isn't passive. Whatever you hit it with, it tries to develop defenses against.

It does this by evolution. Even among the bacteria hit by the first dose of an antibiotic, there may be a few that resist it, taking longer than others to die, or perhaps not dying at all. Furthermore, the survivors of the initial assault reproduce, and some of their offspring will have mutations. Mutations are random, but if there are enough of them, some may be still more resistant to the antibiotic—so

Analog Science Fiction and Fact (*Astounding*) is published monthly except for a combined July/August double issue by Dell Magazines, a division of Crosstown Publications. One-year subscription for $30.97 in the U.S.A. and possessions, in all other countries, $41.97 (GST included in Canada, GST # R126541718) payable in advance in U.S. funds. First copy of new subscription will be mailed within eight weeks of receipt of order. When reporting change of address, allow 8 to 8 weeks and give new address as well as the old address as it appears on the last label. Periodical postage paid at New York, NY, and at additional mailing offices. Postage (Canadian postage paid at Windsor, Ontario, Canada Post International Publications Mail Product Sales Agreement No. 260622. © 1995 by Dell Magazines, a division of Crosstown Publications. All rights reserved. Protection secured under the Universal Copyright Convention. Reproduction or use of editorial or pictorial content in any manner without express permission is prohibited. All stories in this magazine are fiction. No actual persons are depicted by name or character. Any similarity is coincidental. All submissions must be accompanied by stamped self-addressed envelope; the publisher assumes no responsibility for unsolicited manuscripts or artwork. USPS 488-910, ISSN 1059-2113

POSTMASTER: Send change of address to: ANALOG SCIENCE FICTION AND FACT
P.O. Box 54625, Boulder, CO 80328-4625
IN CANADA RETURN TO: 3255 WYANDOTTE STREET EAST, WINDSOR, ONT. CANADA N8Y 1E9
Editorial and Advertising: **Analog Science Fiction and Fact, 1270 Avenue of the Americas, New York, NY 10020**
Subscriptions: **Analog Science Fiction and Fact, P.O. Box 54625, Boulder, CO 80322-4625**

Printed in the U.S.A.

LICENSED TO UNZ.ORG
ELECTRONIC REPRODUCTION PROHIBITED

their offspring will be better able to proliferate despite the antibiotics' efforts to exterminate them.

Biological history has largely been a history of microorganisms and their hosts evolving new means of attack and counterattack. Antibiotics amount to an evolutionary leap for "our side," but the evolutionary game is one in which the microbes have their own secret weapon—something that we know about but can't duplicate. That is reproductive speed. Evolution is inefficient, but bacteria go through generations a lot faster than we do, so they can evolve new forms much faster.

If you use an antibiotic rarely, when you really need it and *only* when you really need it, it's effective because the enemy hasn't evolved defenses against it, and has little chance to do so if it doesn't encounter the same antibiotic again. But if you use it often, they get a lot of chances to try new defenses, and they may well find one that works.

That's what we've been doing, and that's what's been happening. When we use an antibiotic so often that the bacteria can evolve an effective defense, then we have to develop a *new* secret weapon—but we're slower at that. We do, of course, have a relatively new weapon in our arsenal that can play a somewhat similar role to rapid reproduction and evolution. We have fast computers that we can use to simulate the effects of new drugs. But simulations are only simulations, and only as good as what they have in their databases—which must be based on reality. Furthermore, they can't anticipate the enemy's next moves, since those are based on trying lots of things at *random*.

STANLEY SCHMIDT.....Editor
SHEILA WILLIAMS.....Managing Editor
DANIEL IMAL.....Assistant Editor
JARED GOLDMAN.....Editorial Assistant
MONICA GAIGE-ROSENSWEIG.....Creative Director
SHIRLEY CHAN LEVI.....Assistant Art Director
CAROLE DIXON.....Production Manager
KATHLEEN HALLIGAN.....Associate Manager, Subsidiary Rights and Marketing

BRUCE W. SHERBOW.....Director of Newsstand Sales
SANDY MARLOWE.....Circulation Services

CHRISTINE BEGLEY.....Associate Publisher

Published since 1930

PETER KANTER
Publisher

ADVERTISING REPRESENTATIVE
David Geller Publishers' Rep.
(212) 682-1540

First issue of Astounding January 1930 ©

EDITORIAL CORRESPONDENCE ONLY
CompuServe: 71154,662 Internet: 71154.662@compuserve.com

LICENSED TO UNZ.ORG
ELECTRONIC REPRODUCTION PROHIBITED

MICHAEL FLYNN

FIRESTAR

A NOVEL OF THE FUTURE IN THE MAKING

"*Firestar* is an extraordinary achievement, beautifully and vividly written, full of real people, the story exciting, many-sided, sometimes funny, sometimes sad, ultimately triumphant, altogether believable—the history of the future that can be ours, in our own lifetimes, if only we have the vision and the courage to create it. I can't wait to find out what happens next!"

—Poul Anderson

1988 HARDCOVER

LICENSED TO UNZ.ORG
ELECTRONIC REPRODUCTION PROHIBITED

Overdependence on antibiotics also has another bad effect with a military analog. It reduces the chance for our immune systems to keep in practice at fighting off microbes on their own, and to develop new methods of dealing with mutated microbes. It's a bit like a military commander deciding that once he has big bombs, he can disband his infantry—and then finding his own cities overrun with the enemy's infantry. If you've ever lived in a place where antibiotics were hard to come by, or even read about such a place, you'll understand that there's a lot to be said for keeping your built-in immune system as strong, resilient, and independent as possible.

So, in a simpleminded way, the argument for using antibiotics with restraint essentially boils down to one long familiar on more prosaic, macroscopic battlefields. If you've got a secret weapon, you only want to take it out when you really need it, because you don't want the enemy to have too much chance to develop defenses against it. And when you're *not* relying on your secret weapon, you'll want to make sure your infantry—or your immune system—is kept well-trained, equipped, and up-to-date. ■

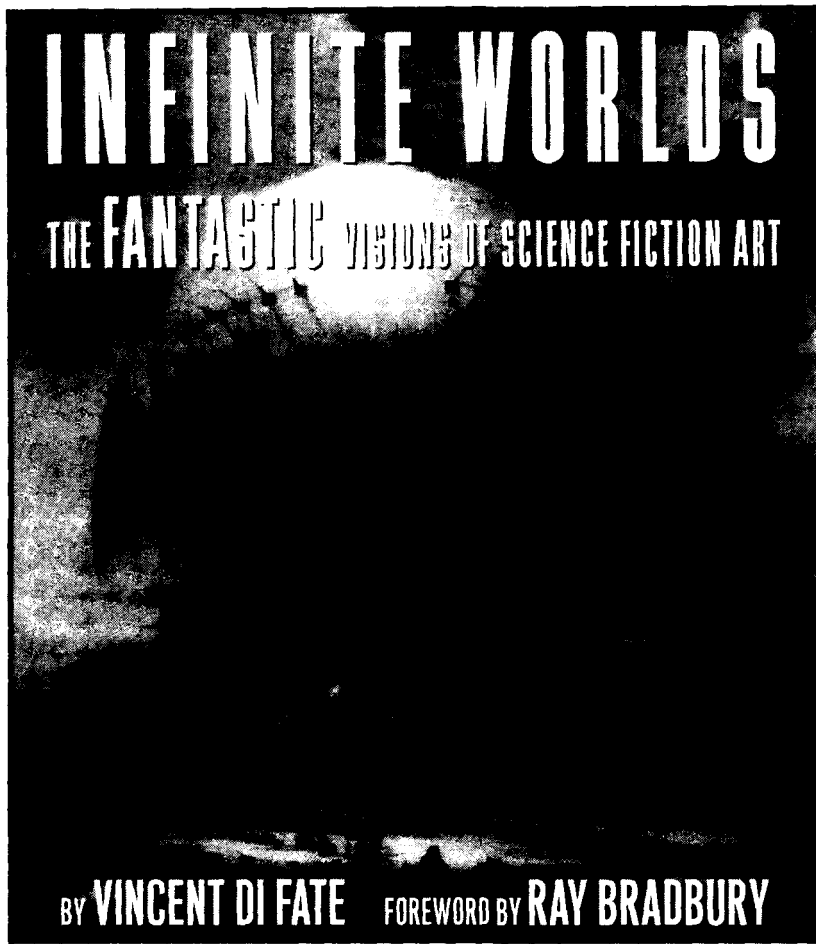
Horror can still be triggered by people who are dedicated to doing it, and there's something optimistic in the fact that people can still, in spite of all the world's real horrors, be brought to the point of the scream by something that is patently impossible.

—Stephen King

Cats hate water only when it is dumped on them, as who wouldn't? Given the opportunity, they will fish diligently in the neighborhood fish ponds.

—Eric Temple Bell

LICENSED TO UNZ.ORG
ELECTRONIC REPRODUCTION PROHIBITED



From movie posters to book covers, from raging raptors to video villains, here is the definitive collection of science fiction art. Artist Vincent di Fate has compiled nearly 700 images from the worlds of science fiction literature, television, and film to represent 150 years of graphic imagination, including work by Frank Frazettta, Michael Whelan, Leo and Diane Dillon, and many others. With its dazzling four-color illustrations and fascinating text, *Infinite Worlds* is a treasure every art and science fiction devotee will want to own.

$45.00
IN BOOKSTORES NOW FROM PENGUIN STUDIO
or call 1-800-253-6476 to order

© The Wonderland Press

LICENSED TO UNZ.ORG
ELECTRONIC REPRODUCTION PROHIBITED

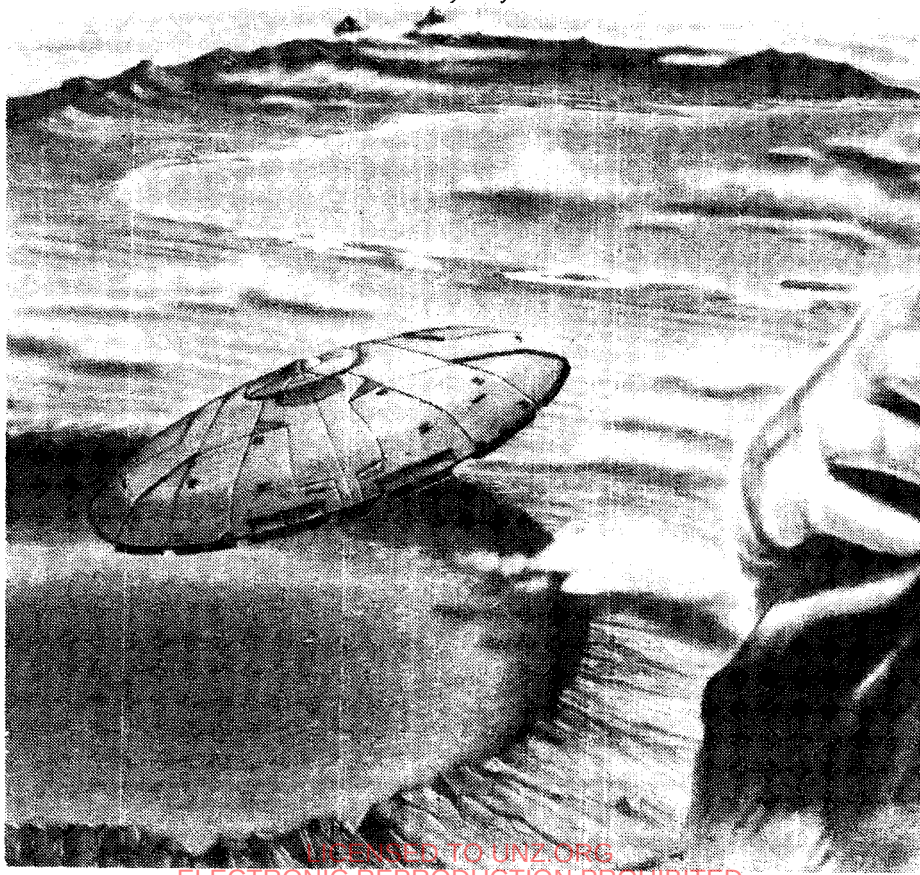
Part One of Four

Joan Slonczewski

The Children Star

If a world is alien enough, settlers might live there for quite some time while failing completely to understand what it is. . . .

Illustration by Darryl Elliott



LICENSED TO UNZ.ORG
ELECTRONIC REPRODUCTION PROHIBITED

LICENSED TO UNZ.ORG
ELECTRONIC REPRODUCTION PROHIBITED

PART I

CHAPTER 1

The sun crawled steadily up behind the dying city. Its rays stretched across towers and avenues to the hillside, through the window of a shack, to the eyelids of six-year-old 'jum. The sunbeams teased 'jum to wake up and look out upon Reyo City, and count the many lightcraft rising to meet the ships in orbit around L'li. But when she woke, her belly gnawed inside. Above Reyo, one glowing lightcraft rose, another came down . . . not the thousands she used to count. So she counted the sunbeams instead. So many sunbeams peeked out through the skyline that even 'jum could never count them all.

From behind she heard a scratching sound. In the corner scrabbled a rat, its nose twitching hopefully. 'jum watched the rat. Blood pounded in her ears, and her belly gnawed harder.

She felt in her pocket and grasped a stone, a good heavy one, while her eye still fixed on the rat. With all her strength she flung the stone.

Red lights flashed across her eyes, and her ears rang. But the rat lay there, twitching and squeaking, so she dragged herself over to it. After she broke its neck it lay still.

From outside came the cry of a crow, the whine of a beggar, the grating of a wheelbarrow up the steep path. Once, the shacks that crowded the hillside would have all been stirring by now, with sweepers, garbage pickers, a seller of tin scrap in the doorway. Now all were gone.

The wheelbarrow grated again and came to rest just outside. A hoarse voice called, "Any dead?"

The call had become a part of the morning routine, since the "creeping" had spread. The creeping began as a numbness in the fingers and toes that crept upward over several months. It spread amongst people living together; how, 'jum did not know.

"Any dead?" The call came closer now, and the barrow came to a halt just outside. Usually, 'jum's mother would call to her from her bed, for 'jum to go out and answer. Of course, if no one answered, the man would just come in. Such a man with such a barrow had come in before, first for her sister, then her brother, then at last her father. Then the factory where 'jum worked had found out and sent her home. No more days of counting strange bits of metal to piece together—one thousand twenty-one, one thousand twenty-two—only the lightcraft to be counted, and the windows in the proud towers that reared opposite the hillside.

With an effort 'jum pulled herself up and pulled the paper back from the doorway. The man's grayish brown arms poked like sticks through his cloak. His cart already held two twisted bodies. Now he stared back at 'jum.

'jum closed her lips tight and shook her head.

Expressionless, the man picked up the two handles of the barrow. The wheels creaked: *one-and . . . two-and . . .* 'jum held onto their rhythmic sound. One always comes before two, and the digits of any number divisible by three add up to be divisible by

LICENSED TO UNZ.ORG
ELECTRONIC REPRODUCTION PROHIBITED

three. As her family had subtracted, one by one, 'jum had added and multiplied, creating families of factors in her head. Six hundred ninety-three was a family of four: a seven, eleven, and twin threes . . .

'jum bit into the rat, tearing out its flesh as best she could. Then she thought of her mother, who could no longer rise from her sleeping mat and needed 'jum to feed her. 'jum felt her way across the room, lighted only by the window, to the mat where her mother slept, covered by a sack 'jum had salvaged from the factory still bearing the sign of Hyalite Nanotech. Her mother's hand lay across it in the same position as the night before. Yet something had changed; the color of her hand was different, grayer. 'jum reached over and touched her mother's hand.

The hand was a frozen claw. 'jum shivered all over, as if the cold from the hand seeped through her body.

The next thing she knew, she was standing outside, leaning against the shack. Her breath heaved, and her heart thumped as if it would burst from her chest. Behind her, the shack had filled with a chill emptiness that reached for her next.

She tried to run, but the effort of rushing outside had exhausted her. She stared out over the roofs of the shacks that clung to the hillside, to the office towers of Reyo. From the top of one tower a lightcraft grew a golden cone and rose to the sky. Above the towers shone a bright star. Her mother had called it the Children Star, a faraway paradise that children were born to when they died.

A cloud dimmed the sun, and now 'jum's eyes could make out the windows in the towers. Broken panes hinted that even the most well off had not escaped the creeping. 'jum calmed herself the one way she knew how, by counting the windows up and across; five times nine made forty-five, three times ten made thirty, and so on. In the old days at the factory she could have spent all day thus, counting the metal parts in an unlit room.

As 'jum counted, a man in a pale hooded robe climbed up the hill, along the rutted path that the carts barely managed. The man strode purposefully. For a moment he paused, as if looking for someone. Then he resumed his pace and came over deliberately to face 'jum. His figure towered over her, blocking the sun and the city. One so erect and strong could scarcely be mortal; he must be a god. Perhaps the very god of Death.

"Is that your home, little one?" Death's voice was low, and his accent had a foreign edge. 'jum could only stare wonderingly. The hooded apparition half turned, as if uncertain. Then he said, "Is your mother home?"

So that was it. Death himself had come for her mother.

But this time, 'jum decided, he would fail. She drew herself up straight, planting her feet before the entrance to the shack. Her left hand dug deep into her pocket for the largest stone she had. As she clasped it, her eye judged her aim for the critical part of his anatomy.

Death awaited her reply. Hearing none, he took something from his

LICENSED TO UNZ.ORG
ELECTRONIC REPRODUCTION PROHIBITED

cloak and held it out to her. It was a chunk of bread.

The smell of the bread overpowered her so that she nearly fainted. She took the bread and tried to stuff it whole into her mouth, then she choked as her throat was so dry. Expecting this, he produced a flask of water, miraculously clear and fresh. For the next few minutes she applied herself to consuming the bread and water, forgetting anything else existed. She barely noticed as he passed her to enter the shack, then came out.

"Child," he said, putting his hood back so that wisps of hair blew across his face. "What is your name?"

'jum did not answer. Her name meant "pig urine," which her mother had intended to discourage evil spirits after losing two previous infants. But now she scanned the man's face. He was younger than she had thought, his cheeks smooth and tanned, with a neatly cropped beard. His blue eyes fairly glowed.

Something glinted on his chest, something hung on a chain. It was a transparent stone, as blue as his eyes. A sunbeam struck it, revealing a hidden star within; a star composed of three intercepting shafts. The star could define six triangles, with six sides shared and six outside, and seven connecting points.

"You may call me Brother Rod." His voice interrupted her study of the stone. "Come with me," said Brother Rod. "You'll always have enough to eat, where we're going. It's a different world, far from here, at a far star."

At that, 'jum's lips parted and her eyes widened. "The Children Star."

He smiled, like her older brother used to. "'The Children Star,'" he repeated. "That would be a good name for it."

By this time two beggars had found Brother Rod, and they grasped his cloak, whining for bread. He took out more bread and distributed it, while leading 'jum up the path to the top of the hill. When the bread was gone he spread his hands, but the beggars keened after him. So he gave them some coins, and his watch. Then he drew himself up and sketched a strange sign in the air. "The Spirit be with you, citizens." His voice was firm, and the muscles rippled in his forearm. The beggars moved off.

At the top of the hill Brother Rod came to a halt. In the sky a glowing disk descended beneath a cone of boiling air. As the lightcraft came near, it hissed ever louder, and its heat baked 'jum's face. But she stood there bravely until the craft settled upon the hill.

The lightcraft rose on its beam of microwaves, lifting Brother Rhodonite and the child toward the ship that would soon cross the space folds. His last child that year, Rod realized with a wrench in his heart. L'li had once been a beautiful world, but its forty billion humans had long ago tilled its last acre and filled its last air with haze. Only the "creeping" had finally reversed its growth and started a ghastly decline. Elsewhere in the Free Fold, citizens of other worlds either shrugged in despair, or felt secret relief that something at last would curb the L'liite population. Rod sketched a

LICENSED TO UNZ.ORG
ELECTRONIC REPRODUCTION PROHIBITED

starsign and silently prayed the Spirit to heal them all.

The Sacred Order of the Spirit was the most ancient religious order in the Fold. Their roots reached back before the Free Fold, to Valedon, the gemstone world, in an age when world warred against world. The Valan sapphire star with its three shafts of light spelled the three-fold call of truth, grace, and spirit; and wherever these were needed, Spirit Callers went. Brother Rod had been called to L'li.

"Thanks for the smooth ride," he told the lightcraft. Foreign money kept L'liite transport running for the tourists, but declined to cure her citizens.

"You're welcome, Citizen." The lightcraft was an electronic sentient, no mere servo machine. Modern Valedon was known for both, and Rod knew better than to miss the difference. "I don't often take passengers from that hill; and if things keep getting worse, I'll quit the planet altogether. Do you return to Valedon, Brother Rhodonite?"

"No, Citizen. To Prokaryon."

Prokaryon was a virginal frontier world, at a star two space-folds away. With his fellow Callers, Rod collected dying orphans to join a small colony on Prokaryon. The child he had just collected was pale with fear; Rod held her close, wishing he could explain the wonders her future held on a world full of food, free of "creeping."

"Prokaryon!" exclaimed the lightcraft. "Are you human? I hope your cells have good arsenic pumps."

Rod smiled. "They do." Unlike Valedon, Prokaryon was not terraformed, for today the Fold forbade alien ecocide. But Prokaryon's alien ecology, full of arsenic and triplex DNA, poisoned human bodies. Unless, of course, they were lifeshaped, their genes modified to survive. Lifeshaping took best in young children.

Out the viewport, the boarding station loomed ahead, its hull displaying the vista of ancient L'liite temples, though nowadays they could barely be reached in safety. The lightcraft docked, and its round door fused to that of the station like two mouths kissing. An entrance opened through the fused doors and widened into a corridor.

Above the corridor, floating fingers pointed to Rod's feet. "Watch your step," a voice whispered in six languages.

Rod caught the child's hand, remembering that she might never have seen such a place. He ignored the virtual newscaster announcing new jump holes through the space folds, and new Elysian bank deals to finance copper mines on Prokaryon. Virtual doorways juxtaposed Reyo City's nightlife with that of Elysium—the wealthiest world of the Fold, where people kept young for a thousand years. Rod himself would have taken such a tour, as a young Guardsman on leave. But he had left all that behind, ten years before, to follow the Spirit.

At his cabin, the door molded itself open. Rod sketched a starsign to his fellow traveler, Brother Geode.

"Back at last, Brother." One of Geode's six limbs sketched the star in return. "What kept you so long?" Like the lightcraft, Brother Geode was a

LICENSED TO UNZ.ORG
ELECTRONIC REPRODUCTION PROHIBITED

sentient. Self-aware machines were called "sentients"ever since their revolt against their human creators two centuries before. Sentients were built of nanoplast, consisting of trillions of microscopic servos. Geode himself had a torso of nanoplast about the size and shape of a pillow, with his star sapphire nearly buried in blue fur. His nanoplastic limbs could extend and mold themselves to any length and thinness. His limbs sported fur in each of the primary colors, giving him the appearance of a giant multi- colored tarantula.

At the moment, Brother Geode had one red furry limb cupped to cradle a tiny infant, while a yellow limb fed it cultured breast milk. Three other infants slept in nanoplastic nooks nearby; the entire ship itself was a sentient. Brother Rod had brought all four of the infants from an orphanage in Reyo. The orphanage had run out of formula months ago; the infants, just left there that day, would not have lasted the week.

"I found one more Spirit child."

The girl flexed her toes in the carpet and stared wide-eyed at the sight of Geode.

From a nook in the wall, a baby several weeks old awoke with a cry and stretched his trembling arms. Rod went over and swaddled him, then tucked him under his arm, as a bottle slid out from the dispensary window. The bottle held breast milk as "real" as a mother's, including cultured lymphocytes. The infant soon settled against his chest, gazing upward into Rod's eyes. With barely more weight on him than the newborns, his limbs were wobbly sticks, but the milk would bring him round. How resilient infants were.

Geode's two eye stalks rose from his torso like periscopes and trained on the girl. "An *older* child?" He spoke in Elysian, the language sentients preferred; they, like Elysians, were forever young. "An older child—not again. You've grown soft, Brother."

"She looks barely two."

"Malnourished. She's six if I'm a day. An older child," Geode repeated. "You know what the Reverend Mother will say."

The Reverend Mother Artemis had founded their colony on Prokaryon. It was she who first called Rod to the Spirit, in his final year at the Guard Academy. He still he could not think of her except with a sense of awe.

"The Reverend Mother will say we cast our nets well," Rod replied. "I climbed the hill and brought what I found. Not a child under five was left alive."

"She'll spend a year in the gene clinic, vomiting half the time," Geode added, "and we'll be the next ten years paying her off." Infants up to eighteen months could be processed in a couple of weeks; older children took much longer, and adults might never make it. Rod himself had spent three years in treatment, yet he still could eat nothing grown on Prokaryon.

Was Geode right, he wondered. The child's eyes had arrested him there in the street, and clutched his heart against his reason . . . . But the Spirit within had called to him, saying, Rod always listened when the Spirit called.

LICENSED TO UNZ.ORG
ELECTRONIC REPRODUCTION PROHIBITED

ANALOG AND ASIMOV'S SCIENCE FICTION MAGAZINES

Combo Classified Advertising Order Form

MAIL TO

DELL MAGAZINES
attn: Carole Dixon
Classified Advertising Dept.
10th Floor
1270 Avenue of the Americas
New York, NY 10020

15 WORDS MINIMUM
Only $72.00 for 15 Words or Less.
$4.80 Each Additional Word.
Capitalized Words Add $.60 per Word.

SAVE 15% WITH 3 CONSECUTIVE MONTHS SAME COPY ORDER

DEADLINE: Copy and payment must be in by the 5th day of the 4th preceding month for issue in which ad is to appear.

PLEASE PRINT OR TYPE

Your Name _____

Firm (Name in Ad) _____

Address _____

City State Zip _____

Phone _____ Date _____

Your Signature _____

Basic rate	$72.00
_____ Additional words at $4.80 each.	_____
_____ Capitalized words at $.60 each.	_____
Total amount for 1 ad	$ _____

15% Savings With 3 Consecutive Month Discount

a. Multiply one ad total $_____ x 3 = $

b. Multiply total amount on above line by x .85 x .85

c. Total amount for 3 ads $

$ _____ is enclosed for _____ insertion(s) in the next available issue(s)

Specify heading _____

FOR ADDITIONAL WORDS ATTACH SEPARATE SHEET

(1) $72.00	(2) $72.00	(3) $72.00	(4) $72.00	(5) $72.00
(6) $72.00	(7) $72.00	(8) $72.00	(9) $72.00	(10) $72.00
(11) $72.00	(12) $72.00	(13) $72.00	(14) $72.00	(15) $72.00
(16) $76.80	(17) $81.60	(18) $86.40	(19) $91.20	(20) $96.00
(21) $100.80	(22) $105.60	(23) $110.40	(24) $115.20	(25) $120.00
(26) $124.80	(27) $129.60	(28) $134.40	(29) $139.20	(30) $144.00

HOW TO COUNT WORDS: Name and address must be included in counting the number of words in your ad. Each initial or group of figures (as a year) is a word. City and state count as 1 word each. (Garden City, New York counts as 2 words.) Zip codes are 1 word. Abbreviations (like 1270 Avenue of the Americas, New York, New York 10020 count as 8 words.) Phone numbers are 1 word. Abbreviations such as COD FOB PO USA 7x10 35mm count as 1 word. PO Box 145 counts as 2 words.

PLEASE MAKE CHECKS PAYABLE TO DELL MAGAZINES

LICENSED TO UNZ.ORG
ELECTRONIC REPRODUCTION PROHIBITED

He adjusted the baby in his arms, holding up the tiny head. Then he turned to the girl. "See, child," he told her in L'liite. "This will be your new brother on Prokaryon. You'll have thirty-nine brothers and sisters—think of it. You'll grow your own food, and even mine your own gemstones."

Geode's eyestalks twisted quizzically. "She hasn't taken her eyes off me. What must she be thinking, to go off with such strangers?"

"What child was not born to strangers?"

Two of Geode's limbs began to mold themselves into probes to examine the girl's health. *"I* was never born. I was built—to precise specifications. I make fewer mistakes than one byte in a trillion trillions."

Rod smiled. "You had to be taught to think."

Ignoring this insult, Geode extended a long, slender tendril out of his furry limb toward the girl, who moved back a step. Brother Rod put his arm around her. "Let Geode treat you, child. He will help your stomach feel better. Then we'll have a good bath, and a good dinner."

The tendril wound around the girl's arm, inserting a microscopic probe which she would not feel. The probe would sample her blood for her own DNA and proteins, as well those of any pathogens. "Her name is 'jum G'hana," Geode announced, matching the gene sequence with his database.

The girl blinked at the sound of her name amidst the foreign gibberish. A sharp mind, Rod thought.

"She was first sampled at approximate age three, upon hiring full time at Hyalite Nanotech. Father died of 'creeping,' mother alive, age—"

"Her mother's dead," Rod corrected. "Creeping" sickness was caused by prions, misfolded proteins that directed normal ones to mimic their structure and accumulate in the motor neurons. Paralysis crept out the limbs and inward. Other prion infections were contained in the nervous system, but the dreaded "creeping" prion leaked out in secretions and transmitted readily.

"She has lice and worms," continued Geode. "And prions, though not yet irreversible." So she did have the disease, as Rod suspected from her mottled legs. Even her relatives, had she any, would never claim her. The emigration forms would go straight through.

The cure for creeping was to inject millions of nanoservos, microscopic servo machines, into the bloodstream to methodically search and reshape the misfolded proteins. It was effective, but expensive. On Prokaryon, the Fold paid to cure colonists, as part of the frontier settlement plan.

"She wasn't badly nourished, her first three years." Geode's infant had done feeding and was now bouncing in one coiled limb. "Maybe she's not even brain-damaged. Say, 'jum," the sentient demanded in L'liite, "did you go to school? Can you read?"

'jum slowly shook her head.

"Can you count your factory wages?"

At that, 'jum did not answer but gave the sentient an intent look.

"What's one plus one?"

LICENSED TO UNZ.ORG
ELECTRONIC REPRODUCTION PROHIBITED

She frowned, as if this were a very difficult problem. "Not quite one-and-a-half," she said in a voice so low that Rod barely heard.

Geode twined his eyestalks disparagingly.

"What do you expect; she's never been to school. Is your workup done? She needs a bath."

"Definitely," the sentient agreed with emphasis. "I don't know, though. I wonder sometimes if we're not half crazy, trying to settle a frontier with starving babies."

"It's the cheapest way," Rod said ironically, for that was the reason of the Fold.

"But—look, you know, it's not just any world, by Torr. It's *Prokaryon.*"

Prokaryon was named for its unique "prokaryotic" life forms. Animal or vegetable, all Prokaryan cells contained circular chromosomes, free of nuclear membranes—like bacteria, *prokaryotes*. But Prokaryan cells were ring-shaped as well. And the higher structure of all the multicellular organisms was toroid, from the photosynthetic "phycoids" that grew tall as trees, to the tire-shaped "zooids" that rolled over the fields they grazed—or preyed upon those that did.

"And I don't care what the Free Fold says," Geode added, "there *are* intelligent aliens running Prokaryon, somewhere."

Such rumors arose whenever a new world was settled, even on Valedon long after it was boiled and terraformed. But Prokaryon had such strangely ordered stripes of vegetation, like a giant garden tended by . . . Who could tell? How would humans ever recognize an "intelligent" creature, if it existed? They took centuries just to recognize the sentients that emerged from their own factories.

Chapter 2

Fed, scrubbed, clothed, and medicated, the six new Spirit children endured their week-long journey through the space folds to Prokaryon. Of course, none of them could yet set foot on their new home. Merely inhaling Prokaryan air would expose their unprepared lungs to poison; for the native life forms had evolved all sorts of things that the ordinary human body was not designed to encounter, much less digest for food. Their triplex chromosomes were mutagenic, their "proteins" contained indigestible amino acids, and their membranes were full of arsenic. Prokaryan cells were not exactly good to eat—unless you were Prokaryan.

So the children's first stop was Station, a giant sentient satellite where human colonists were lifeshaped. The lifeshapers would inject them with nanoservos, microscopic machines to put special genes into the cells of the liver and intestines. The special genes would teach their cells how to detoxify unfamiliar Prokaryon molecules, and to eat them as food. For adults the lifeshaping was slow and inefficient; thus, most Prokaryan colonies depended heavily on sentients. Rod often wondered how the rest of the Fold's worlds would ever have gotten settled, had they all tried to do it thus. Valedon,

LICENSED TO UNZ.ORG
ELECTRONIC REPRODUCTION PROHIBITED

like most of them, had been boiled off and reseeded with human-compatible life-forms. But today people called this "planetary ecocide." Rod himself had been skeptical, until he came to Prokaryon and fell in love with its mysterious beauty. He could not imagine terraforming such a world.

The cylindrical satellite grew until it dwarfed the approaching ship. Aside from the gene clinic, Station housed a research complex. She directed scientists from all worlds of the Fold who came to study Prokaryon's biosphere and confirm its absence of intelligent natives, a legal requirement for exploitation. Above all, she governed Prokaryan settlement on behalf of the Fold.

"All passengers, prepare to disembark." Station's voice entered the ship, as she extended her docking tube.

Brother Geode crawled out on three of his furry limbs, carrying babies in his other three, while Rod carried two and 'jum gamely managed one. The tube rotated steadily, generating about half a unit of centrifugal force, enabling them to walk while keeping their baggage light. But the sense of weight loss alarmed the babies, for their stomachs told them they were falling, no matter how hard Rod clutched them in his arms. The little bundles stiffened, then emptied their lungs to howl. Overhead, upside-down in the cylinder, two or three travelers stretched their necks at this unusual scene. A gorilla face stared down at Rod; a simian hybrid woman wearing a student's backpack. Rod stared back, for simians were a rarity out here.

Beneath Rod's feet the floor shifted sickeningly. That meant the lock had engaged, and they now stood in the innermost ring of Station. The babies sucked in their breaths and wailed.

"Brother Geode, immigration officer of the Spirit Colony." Station's voice boomed, everpresent within the satellite. "Six new colonists?"

"Yes, Station." Geode bounced the three infants in his arms, trying to quiet them.

"You exceed your quota again."

"Yes, Station."

Rod felt bad. It was his fault they always pushed the immigration limit. In his days at the Guard, he had always tried to steal one last round of shooting beyond regulations; now, he took one more dying child. "They're all healthy," Rod insisted. "They'll be productive citizens."

"And one is an older child. Brother Geode, you will see me for consultation."

"I will," Rod said firmly. They always got away with it before.

"Please sign the release for each."

On the wall a bright rectangle appeared, its text scrolling past absurdly fast. Rod had no need to read the contents. The release form required all immigrants to acknowledge that Prokaryon's biosphere was only partly understood, and its climate not yet controlled, and that the appearance of any plague threatening the Fold might require defensive action—before all inhabitants could be evacuated. Rod despised the provision, and its authors in the Fold Council, who

LICENSED TO UNZ.ORG
ELECTRONIC REPRODUCTION PROHIBITED

feared another prion plague. Prions arose from human bodies, not from a world where humans could barely live.

Geode held up his infants to press the document with their toes, and Rod did likewise.

"Reverend Mother is coming," said Geode. Sentients communicated by internal radio. At the gate stood the Reverend Mother Artemis. Her sapphire star gleamed where a human neck would be. Around her face twined restless strands of nanoplastic "hair," as if individually alive. Below her neck hung multiple breasts, and her robe revealed skirts full of holographic bears, lions, even flying fish from the Elysian ocean. Children were her life work, ever since she herself had been manufactured to raise wealthy Elysians. After earning her freedom as a sentient, she had joined the Sacred Order.

The Reverend Mother's nanoplastic hand traced a six-pointed star. "Brother Rod. You return with your nets full." She took the two little ones, who quieted as they stared.

Rod returned the sign. "I wish it could be otherwise."

"So do we all." Her face was a screen across which her "features" shaped and reshaped in ever changing colors. "We call on the Spirit to hear the agony of the L'liites. But this mystery has endless depth and no shore."

"How are the children back home?" He always felt sure the little ones would not get to sleep without him.

"All well, thank the Spirit. The phycoids are ready for harvest, and T'kun found a perfect pink crystal in the stream."

"Well, we bring you future harvesters."

Geode warned in Elysian, "One of them will cost us a bundle."

"And which *one* would that be?" The Reverend Mother scooped up another infant from him. "Which one would you refuse?"

'jum was watching her skirt, mesmerized by the rearing bear. Rod squeezed 'jum's hand encouragingly. "This is the Reverend Mother of the Spirit Colony of Prokaryon. You will be our own child."

The Reverend Mother spread her arms and spoke in clear L'liite. "'jum G'hana, are you my little bird singing in the tree?" Her voice had just the right rhythm, as if she had been born and raised in the streets of Reyo.

'jum ran to her, immediately to be swept up in the arms and skirt. Mother Artemis was always like that.

"There, my little bird. It's too soon for you to talk, isn't it, but won't you shape for me?" Mother Artemis stepped over to the holostage.

Above the holostage a ball of light appeared, as if suspended by magic. Mother Artemis reached to it with her hands and shaped it like a lump of clay. It formed the shape of a flower, with a dozen petals that she pulled one by one, each perfect as a teardrop.

Then a second ball of light appeared. "It's your turn, 'jum. Won't you try? Shape me something from your home."

'jum put out a tentative finger. She poked the ball, and a depression re-

LICENSED TO UNZ.ORG
ELECTRONIC REPRODUCTION PROHIBITED

mained. Encouraged, she pulled it into a tall oblong shape and poked more holes in an orderly array, eight across, row upon row, more than a dozen. It looked like something Rod had seen, but he could not quite put his finger on it.

"That's lovely," Mother Artemis exclaimed. "Was that your house where you lived?"

'jum shook her head. She paused as if in thought. Then abruptly she squeezed the light into an amorphous lump and began shaping again, with precise details. Her sureness suggested that her fingers had shaped such an object before, perhaps many times. It was a box with three prongs at right angles to one another, and two unidentified levers at the side. It looked so realistic, one might pluck it solid from the air.

"What have we here?" Mother Artemis spoke in a low voice. She trained her visual sensors on the object; her true "eyes," set at her neckline, rather than her apparent eyes in her face. She called up a vast database from all the Fold's worlds.

Above the three-pronged image, a shape of red light appeared, similar in form to the one 'jum had made. The red shape descended and merged with the white one; it was nearly a perfect fit.

"It's a lanthanide extractor," the Reverend Mother explained in Elysian.

"Of course," said Geode. "She must have assembled them at the Hyalite plant—thousands of them."

Rod eyed the device sternly. "They're illegal."

"Not their manufacture," said the Reverend Mother, "only the use to which some are put." Lanthanide extractors were used to sort rare-earth minerals from rock. All the inhabited worlds had long ago exhausted their natural supplies of rare-earth elements, prized for many uses in nanocircuitry. So the main place left to use extractors was new planets. But that was against the law of the Fold. A world could be mined only after scientists had established, and the Secretary of the Free Fold decreed, that no intelligent natives had prior claim.

Still, who could police the universe? The Hyalite House, an ancient and respectable firm based on Valedon, put its assembly plant in a decaying L'liite city where starving six-year-olds would not recognize the device, and no one would ask where it ended up.

Geode extended an arm. "They can't use them here." On Prokaryon, mining was permitted only with macroscopic implements, and only up to one percent of the planetary resource, until the new world gained independence and could vhoose for itself.

Mother Artemis turned to 'jum. "You must have made many of those pieces, little bird."

"Two thousand, five hundred and thirty-one," the girl murmured.

"What a number. And you counted every one?"

'jum nodded. "It's a family without children."

Mother Artemis nodded. "You like numbers, don't you? I'll bet you know all your sums."

LICENSED TO UNZ.ORG
ELECTRONIC REPRODUCTION PROHIBITED

'jum lowered her eyes. Then she looked up. "Three plus four is five."

At this unaccountable calculation, Mother Artemis paused. "How about three *times* four?"

"Three times four is twelve."

"Eight times thirteen?"

"One hundred and four."

"What are the factors of three thousand and three?" When 'jum hesitated, she added, "The 'children'?"

"Three, seven, eleven, and thirteen. A family of four children." Then abruptly she burst into tears, crying for her mother. Mother Artemis held her close, knowing she would have a lot more crying to do before she could face a new life. Two of the infants started crying, too.

"I wonder how she's adding," Mother Artemis said in Elysian. "Never mind, she'll learn as fast as a sentient."

Geode's limbs snaked out to lift and comfort the agitated infants. "At least this part of our job will come easy."

"Not much harder," the Reverend Mother warned.

"Humans," groaned Geode, his fifth limb shaking a milk bottle. "How did I ever get into this?" The woolly-armed sentient had shepherded Spirit children for a decade, thought Rod with a smile. Rod was a relative newcomer.

Mother Artemis was whispering to 'jum. "Geode will take good care of you at Station until you're set to join us. You can call me any time you like, on the holostage. Behold—as one of our family, you have a new name: 'jum-so-hana Spirit. And here is your sign," she pinned to 'jum's ragged shirt a sapphire, a clear drop of sparkle tinted pink. Not the deep, stellated blue of a starstone, but a sapphire nonetheless, strained from Prokaryan gravel.

The children would stay at Station with Geode, for their treatments. This left the Spirit Colony understaffed, with only Rod, Mother Artemis, and Brother Patella, a sentient physician, to manage the children on Prokaryon. But within a month the babies could come home. What to do with 'jum thereafter would have to be worked out. They could not afford a skinsuit to protect her.

Before leaving, Rod transferred his holocube of 'jum's old home in Reyo to the brain of Station. Station obligingly shaped a room whose shape and colors roughly matched 'jum's old shack, plus a comfortable mat on the floor, and the food synthesizer put out an "authentic" L'liite meal. Later the child would have to make do with the same inexpensive food pellets that Rod did, until her lifeshaping reached the point that she could eat native crops.

As Rod and the Reverend Mother took their leave, Brother Geode had stretched and lengthened three of his limbs and tied them into an elaborate knot for 'jum. "First off, which is my right arm?" He wiggled the three fuzzy ends projecting from the knot.

'jum inspected closely, then tapped one end. The entire limb turned yellow throughout the knot, revealing its hidden structure.

"Right!" exclaimed the sentient. "Now let's see, how would you undo it?"

LICENSED TO UNZ.ORG
ELECTRONIC REPRODUCTION PROHIBITED

Rod felt proud. A child who learned fast—she might even become the doctor some day, like their own Brother Patella. He had listened well, when the Spirit called him upon that hill.

To reach the planet, the Spirit Colony leased an outdated lightcraft from Station. The craft was not sentient, only programmed to shuttle up and down. Its rectenna had darkened all around, and it bore an acrid smell. Two worn seats held Rod and Mother Artemis, with protective straps that took some time to assemble. The craft shuddered as it launched off, and a small holostage at eye level showed them the satellite shrinking away. Beyond in the blackness appeared the neutrino receiver, a giant silver sphere full of water to detect the massless particles carrying signals through the space folds.

"Brother Patella will be glad to see you back," the Reverend Mother observed. "T'kun smuggled a baby four-eyes into the nursery. And a tumble-round has grown well into the garden; it's looking in at Haemum's window!"

Rod smiled remorsefully. "I've been away too long—and only bring back more trouble."

"Why else are we here?"

The lightcraft whined as it entered the atmosphere, as the air above heated into plasma. Above the holostage, the image of Prokaryon expanded, its green and blues cloaked in cloud, beautiful and terrifying, yet vulnerable, like a woman's eye. As the surface neared, a brilliant expanse of ocean met the shore of their continent, Spirilla, a twisted spiral of green and gray. The world rotated slowly downward beneath the lightcraft. In the western arm of Spirilla, pale scars marked the copper mines. To the east rolled the uncharted interior, circled by glacial mountains.

As the craft fell toward the green, curious patterns emerged. Long dark bands ran in parallel rows, winding like a string picture. The dark bands were singing-tree forest. Each band of forest alternated with a paler band of wheelgrass, merging into wetland, which gave way to the next band of forest. Over and over the same pattern repeated, ceasing only at the mountains.

What Spirit had dipped a finger in the ink of foliage and drawn those lines? And whose hand tended them still? Not a seed of wheelgrass could a human plant on forest land, even with the singing-trees cleared; yet singing-tree pods would only wither where the wheelgrass grew.

The old lightcraft dipped and veered suddenly, caught in a gust of wind. Rod gripped his chair automatically, though it made little difference, as its nanoplastic limbs held him fast. "I hope at least it lands us in the right place." The craft had been known to miss the band of wheelgrass that contained the colony, leaving the passengers to hike through several kilometers of singing-trees.

"Patella doesn't answer," said the Reverend Mother. "Who knows what the young ones are up to."

No answer from Patella? That was odd. Wherever he was, Brother Patella could hear Mother Artemis from

LICENSED TO UNZ.ORG
ELECTRONIC REPRODUCTION PROHIBITED

the lightcraft, then send out Haemum or one of the ten-year-olds with the llamas for them to ride home.

As it happened, they landed in wheelgrass, not far from the trail. The wheelgrass spread in waves all around them. A welcome scent of ginger blew in from the distant singing-trees, always a sign he was really home.

High in the ever-blue sky shone Prokaryon's sun, Iota Pavonis, proud as an albino peacock. The thin ozone layer blocked less of the sun's ultraviolet than on other worlds supporting life. That might be one reason triple-stranded chromosomes had evolved here—to protect DNA from mutation. Prokaryan weather, like its landscape, had a predictable pattern: sunshine every day, with gentle rain in the evening. But far to the east, past the dark line of hills, the clouds could burst into storm. And above the clouds hovered the peaks of Mount Anacon and Mount Helicon. The tallest peaks had been named for the twelve floating cities of Elysium, who had bankrolled the first explorers. They may have regretted the naming, for the mountains proved unlucky, full of landslides and other accidents for hapless prospectors. Many colonists blamed Prokaryon's "hidden masters"—a claim hard to disprove.

Still there was no sign of Haemum's llama, its ears pointing out like flags, its broad feet bred specially to tramp the loopleaves down. Rod turned to Mother Artemis. "No word yet from Brother?"

"He must be running after Gaea and T'kun again."

That would not keep Patella from answering. Patella, like Geode and Mother Artemis, could manage several tasks at once. Unless he was conducting a very complex operation . . . Rod felt a chill at his neck. "I'll go ahead and send the llama back for you."

The Reverend Mother smoothed his shoulder. "The Spirit go with you. Excuse me while I sleep." She drew in her arms, which lost form in the shadows of her sleeves. Her figure seemed to pull itself in and turned gray all over. Rod had seen her "sleep," though she tried to hide it from the children. Sentients had to save their energy, for if their power packs ran out their minds would die. That was their one weakness as colonists.

He returned her touch lightly, thinking, how odd that this gray shape was actually such an extraordinary person. Then he stepped outside. The sun was warm, so he took off his robe, revealing dun-colored everyday trousers much worn and stained. Tucking the robe under his arm, he strode resolutely out into the wheelgrass. The gray-green loopleaves twisted and caught his toe at every step; it took him a quarter hour just to cover the few meters to the trail. High above him several helicoids buzzed as if laughing at him.

Ahead, a herd of four-eyes rolled away like tire tubes, with no legs to get caught in the wheelgrass. Each four-eyes had four compound eyes spaced evenly along the "tread" of its "tire," the upper two eyes alert and watchful, the lower two asleep; the eyes took turns sleeping. In between each pair of eyes was a rasping

LICENSED TO UNZ.ORG
ELECTRONIC REPRODUCTION PROHIBITED

mouth, so each mouth faced downward in turn to consume wheelgrass. Extensible suckers covered the rest of the creature's surface; to move forward, it simply contracted the foremost sucker and lifted up the hindmost, rolling over the wheelgrass. By this repeated motion, the little zoöid could work up a remarkable speed in either direction. Rod hoped no zoöid predator would come barreling after them and mistake him for edible prey.

Once on the clear trail he jogged easily, his feet eating up the miles. A couple of whirrs alighted on his arm, miniature helicoids the size of a pinhead. Finding no zoöid secretions to feed on, the whirrs soon left, very different from the insects he had grown up with on Valedon. The wind brought snatches of song from the singing-trees at the far edge of the wheelgrass. At last the wheelgrass gave way to brokenhearts, golden ringlets that looked like so many lost wedding bands. The protein-rich brokenhearts were cultivated to feed the lifeshaped children.

At last the colony's nursery and dining hall appeared, jutting out of the hillside below the sapphire mine. The long mud-colored buildings were built of a saprophyte growth, pressed into shape and dried hard as wood.

As he approached, twelve-year-old Haemum came running out to meet him. The founding child of the family, she now stood nearly as tall as himself and seemed to be all legs. Her skirt and scarf were made of the same cloth that they all wove and dyed of fibrous loopleaves. She threw her arms around Rod, pressing her black curls to his chest. "Brother Rod, thank the Spirit you're here. We don't know what to do—Brother Patella fell down the ravine, and he must have 'broken' somehow."

"Broken how? Where is he now?"

Two of the boys were running out, ten-year-old Chac and four-year-old T'kun, with his arm ominously bound in a sling. Then little Gaea dragged herself through the dust on her arms, her paralyzed legs trailing behind her. Gaea had spina bifida—Brother Geode had thrown up his woolly arms when Rod picked that one, but so it was. The colony would save enough to reshape her, some day.

"It was T'kun's fault," Haemum explained. "T'kun was running ahead and playing space pirate, and when I called after him he got mad. He tripped and slid down the bank, tumbling over. Brother Patella tried to get him out, but he slipped too and fell farther. Then he turned all gray and lumpy, and wouldn't answer."

Gaea grabbed his ankle and clung, and he nearly lost balance. "Bro-der Rod, T'kun bring home zoöid! We play with zoöid!" *Zoöids in the nursery* would not do; but it would have to wait.

"Did you call Station?" Rod asked Haemum.

"I did, but the medics haven't shown up yet. I finally dragged T'kun back up and set his arm as best I could. . . ."

Rod clenched his fist, then caught it in his palm. As usual the Spirit Colony was not Station's first priority. No billion-credit shipment of ore would be lost if Patella were crippled, or worse.

LICENSED TO UNZ.ORG
ELECTRONIC REPRODUCTION PROHIBITED

"Can the boys lead me out to him?"

I will. I will," cried T'kun.

Rod patted his head. "Good—but be careful. And you, Chae, mind Gaea and the babies." He extricated his ankle from Gaea's fingers and swung her up for Chae, who staggered as he carried her off. "Haemum, you'll need to ride the llamas out for the Reverend Mother: we touched down just west of the trail. Remember, she'll be asleep."

Haemum raced off to fetch the llamas, her skirt flashing colors in the sun. Rod followed T'kun up the trail by the rushing stream, into the hills full of sapphires and other marketable stones. Here the wheelgrass gave way to a coarse dark shrub, with dense loopleaves. A flock of helicoids rose up suddenly, the sunlight glinting on their propellers.

There!" T'kun shouted and tried to point, then winced at the pain in his bound arm.

Rod caught sight of the gray shape, tumbled several meters down a steep bank. It looked nothing like Patella, whose form resembled Geode. He froze, sick at heart. If Patella's nanoplastic body had not fixed itself by now, the news might be bad. Even if his neural circuits were intact, he would have to be shipped back to Elysium to retrain. And the colony would have to do without a doctor.

The emergency squad from Station came at last for Brother Patella. A sleek glowing disk burned its way through the air and set itself down precisely, right on the trail that overlooked the ravine. For a moment Rod envied the sentient lightcraft, then he suppressed the unworthy thought.

From the craft emerged two medical sentients, their bodies shaped like caterpillars. They crawled down the ravine to rescue the injured doctor, not deigning to speak to Rod. As they lifted the shapeless nanoplast into their craft, Rod felt the full shock of his loss. He had worked with Patella ever since he came here; now in an instant, his brother was gone.

Meanwhile, the older children were coming home from the gravel pit with carts full of corundum and occasional gem-quality stones. Mother Artemis, now returned, was nursing the four youngest ones, including the twins Pima and Pomu whom Rod had picked up last year. Then she called the older children over for writing lessons.

Rod checked T'kun's arm, which Haemum seemed to have bound up reasonably straight, as far as he could tell. He would bring the boy up to Station the next day for a scan. In the meantime, the watering tubes for the vegetables had broken down, helicoids hung by their sucker mouths from the gutters, and besides, a tumbleround had invaded the garden.

"Look at it, Brother Rod," Haemum exclaimed. "It's the biggest tumbleround I ever saw."

The tire shape of the tumbleround looked partly deflated, its bottom half collapsed into the ground. Twisted loopleaves stuck out in all directions, some extended to root in the ground. The creature smelled like glue and invariably attracted clouds of thirsty whirrs. A tumbleround generally root-

LICENSED TO UNZ.ORG
ELECTRONIC REPRODUCTION PROHIBITED

ed and grew in one spot for a long while; but under certain conditions, perhaps nitrogen deficiency, some of its vines would root themselves in the ground at one edge, then contract, pulling the organism to tumble it over slightly. More vines then rooted down, and so forth; once the tumbleround got going, it could travel a couple of meters per day, trampling and digesting whatever vegetation crossed its path. Scientists disputed whether they were more animal or plant, zoöid or phycoid; "phycozoöid" was the term in favor.

Whether plant or animal, this one was half again as tall as Rod and twice his girth, and perhaps five times his weight. For a moment he felt lightheaded, and he caught himself up just in time. Then he realized that he had not gotten around to eating anything since breakfast on the ship.

He shook himself and straightened. "Well, Sister—what shall we do with our guest?"

Haemum put her hands on her hips. "We could chop it up. If we chop the pieces small enough, they won't grow back. We can scoop them out and dry the hide to make shoes."

A tedious, gruesome task, but it would work. And yet . . . . Why had this thing come looking in the window? What if this whirr-clouded beast really was one of the planet's hidden masters? Station said no, tumbleounds had no IQ to speak of.

"We'll dig it out and haul it off," Rod decided. So they set to work with the shovels, all the while brushing whirrs out of their eyes and mouths, taking breaks when the fumes overpowered them. A sentient lifter could have done it in a minute, but the colony could not afford such. The work of one's hands was a gift to the Spirit.

At last, Rod raised the stinking creature out of its hole, where the loops of its roots lay gashed. His muscles bulged as he lifted it onto the cart. Three llamas pulled the cart, spitting in protest, while the two colonists pushed from behind, driving it out as far as they could before they dumped the tumbleround out. It would root again in no time—and probably return to the garden.

Just before dinner, while helping Pima and Pomu wash their faces, Rod remembered to call Geode. So he hurried off down the hall to the holostage. The twins, who immediately knew what he was after, plodded after him excitedly.

As Rod entered the cylindrical chamber, the usual column of light shone up from the stage; the twins cooed in delight. Soon Brother Geode himself appeared, full of good spirits and just as delighted to see them. "My two little dears!" the sentient exclaimed. "Alike as two parts from the same factory—and walking, already! Why, we weren't gone but three weeks."

"I thought you'd be pleased," said Rod. "But I'm sorry about Patella."

"I can't believe it. I just can't bear to think of it." Three of his arms waved violently in the air, twining and untwining. He and Patella had been built to the same model and shipped from the same Hyalite plant on Valedon. Both had earned their freedom in an

LICENSED TO UNZ.ORG
ELECTRONIC REPRODUCTION PROHIBITED

Elysian nursery, as had Mother Artemis. "I just hope his central processor's OK, so he can reshape himself." He shuddered all over. "How will you ever manage? I'd better come down."

"But the babies need you. How is Jum?"

"Jum is right here. Don't shrink away, girl—look, here's Brother Rod."

The light-shape of Jum appeared, wide-eyed and uncertain. She extended her arm, then pulled it back as if remembering. Rod felt bad about leaving her, though they had no choice. "I'll come up soon to hug you, Jum. Look," he said, nudging the twins. "See your little brothers. We all can't wait to have you home."

As he finally went in to dinner, Haemum was leading the singing at the head of one of the two long tables. *"Let us love only truth, desire only grace, and know only Spirit. . .* Haemum took her devotions seriously, and planned to join the order when she came of age. The children were a cheery sight, their star stones flashing on their necks, all seated in orderly rows in their bright red and yellow patterned shifts. Their legs swung briskly under the chairs, and the long tables reminded Rod incongruously of mealtimes at the Guard Academy.

Soon the bowls of four-eyes stew came passing down, with red and green loop fruits the boys had cooked up from the garden. Since Rod could not yet eat them, Chae brought him his two cakes of standard grade food from the synthesizer. The synthesizer reshaped organic matter at the molecular level, and filtered out toxic metals. An economy model, it put out two flavors, fruit or flesh; Rod had eaten them for so long that he forgot which was which. But the first bite reminded him he was famished. He ate quickly, forgetting his usual insistence on "civilized" conversation.

Someone was kicking him beneath the table. It was T'kun, managing to eat with his left arm. "T'kun, remember your manners," Rod warned. "The Spirit is watching."

A commotion erupted at the far end. A helicoid asleep on the ceiling apparently had fallen onto someone's plate. The children were shrieking; Mother Artemis calmed them, while Rod released the helicoid outdoors. Looking upward, he saw two more helicoids hanging by their suckers from the rafters. The hall really needed cleaning out.

Returning to his place, he found that T'kun had crawled under the table because he did not like the pudding for dessert.

"Come out and sit down," Rod warned, slightly raising his voice.

T'kun dutifully emerged. "I *am* sitting down."

Mother Artemis came over and leaned by his ear. "Rod, I've just heard from Station. Patella can't recover here—he must ship back to Elysium."

His last hope died. There was nothing they could do for the injured sentient except ship him back across the Fold to Elysium, some thirty light-years away. Poor Patella. "What will we do?" he whispered. It was hard enough with just the two of them managing here, until Geode brought

LICENSED TO UNZ.ORG
ELECTRONIC REPRODUCTION PROHIBITED

the babies home; but even then, they needed a doctor. It would take some searching to find either a sentient willing to come, or a human physician willing to be lifeshaped, with two years in the gene tank before she or he dared set foot here without a skinsuit.

Mother Artemis said, "The Reverend Father will find someone." The Most Reverend Father of Dolomoth, a large Valan congregation, had founded their colony and was ultimately responsible for it. "Meanwhile, I could take on a medicine module. It would overload my processor somewhat and slow my reactions, but—"

Rod shook his head. "You can't do that. You have to keep alert around here—you don't want to . . . to get hurt like Patella."

Mother Artemis thought a moment. "There's always Sarai."

Sarai was a Sharer lifeshaper. Sharers were a human race who had settled the ocean world of Elysium ten millennia before the "immortals" did, and shaped their own genes for aquatic life. Sarai however was a rebel among her kind. She had left her ocean home for Prokaryon, to dwell deep within the rock of Mount Anaeon. Rod frowned. "Sarai is hard enough to reach." And not usually receptive to visitors.

"She is as skilled as any Elysian doctor, and she would help the children." Mother Artemis added thoughtfully, "More contact with fellow humans will be good for Sarai."

Rod prayed the children stayed well.

Commotion erupted again, this time from Pima and Pomu, who were attempting to rise from the table. Under the table T'kun had tied their shoelaces together.

After dinner everyone gathered outside. The sun was just setting beyond the distant singing-trees. The llamas groaned at the sun, their regular habit in the evening.

Mother Artemis stood, and her nanoplastic hair waved above her head as if charged by an electrical storm. She spread her robe, and her skirts came alive with bears and lions. Strange story figures shimmered and stepped out around her; the nearer children tucked in their feet and hitched back a bit. The colors deepened to violet, in waving shades of water. Suddenly a figure leaped out of the skirt, a wonderful flying fish. The fish spread its fan-like wings, and began to speak in an otherworldly voice, telling the Sharer tale of how the first fish came to fly, and why their souls were haunted, never again to rest at peace in the sea.

The children were spellbound through tale after tale, legends from Valedon and Urulan and every known world, until at last the younger ones dozed off. Rod put the twins to bed, and Haemum took T'kun. The sun was down now, but the soft remains of light diffused through the gathering clouds. A light rain was falling, as it nearly always did at this hour; Prokaryan weather was remarkably ordered and predictable. The smell of ginger increased as the soil released its fragrance. The voice of the distant singing-trees abated.

LICENSED TO UNZ.ORG
ELECTRONIC REPRODUCTION PROHIBITED

Rod was dead tired, but somehow his mind would not yet let him sleep. He strode restlessly outside the compound, letting the raindrops cool his face and sink into his robe.

He found Mother Artemis walking with him. "How was L'li?"

There was too much inside him to tell. The very edge of certain thoughts made his stomach contract. "Those who had money still have it. But some have the creeping, too—and the cure does not work on advanced cases."

"Yes," she nodded, her darkened robe swishing. "But you did not spend your time among the rich."

"The lightcraft are still running; for how much longer, I don't know. A power blackout downed several. Next time I may not even be able to reach Reyo."

She nodded again. To the east the clouds parted, revealing a large red moon whose glow filled Mother Artemis's restless snakes of hair. The moon glowed red from the sentients melting out its iron. Prokaryon's moon had no known life, and by the next decade it would be mined down to nothing.

"The village I visited last year is deserted now," Rod continued. "The hill I climbed this year will be empty next year."

Mother Artemis kept walking.

"I gave the beggars what bread I had."

"I am sure you gave them everything."

"My watch, and my leftover credits." The colony's own cash was scarce. "But not my pocket holostage," he added remorsefully. "They could have sold that."

"They could," she agreed. "Was that the worst thing?"

His stomach tightened unbearably. "There was a woman outside the orphanage," he forced himself to say. "She tried to make me take her baby." He could not take children of living parents, lest the nationalists cause trouble. "Otherwise, she said, she would take it to the market, rather than see it starve." It was not a slave market.

Suddenly he retched, and his stomach finally gave up. "That was foolish," he said, wiping his mouth, thinking of the wasted food. "I must get to sleep."

"Yes, you must. Even though you want to go back and save all of L'li."

"I do," he said with a touch of anger, at the universe and at himself. "It's appalling, and we all just—live here."

"You saved six children this time; isn't that a great privilege? How many people live their entire lives without saving one soul? And the Spirit should grant you a world?"

He stopped and looked closely at her. Was she laughing at him? "Yes," he said, his mouth smiling despite himself, "the Spirit should grant me a world."

At last, finishing his nightly meditation, Rod found himself in bed. Patella came to mind, and he missed him terribly. Then came the face of his father on Valedon, reproaching him: What did you do with all your expensive schooling, to join a bunch of cler-

LICENSED TO UNZ.ORG
ELECTRONIC REPRODUCTION PROHIBITED

ics raising orphans at a distant star? Then, nameless faces and hands arose until his mind cried out.

There was a tap at the door.

"Brother Rod?" It was T'kun. "My arm hurts."

Rod pulled back the covers. T'kun was supposed to have outgrown sleeping in bed with him, but he would make an exception. The boy snuggled under the covers, his little head a miracle of softness. In an instant Rod was asleep.

Chapter 3

The next day Rod awoke with a sore shoulder, a muscle pulled from hauling the giant tumbleround the day before. Nonetheless he felt well rested, and the sight of the cloud-cloaked mountains always brought him peace. He spent the first hour with Gaea dragging herself after him and wrapping herself around his leg at every opportunity. The Spirit callers cared equally for all, but despite himself Rod had favorites.

Haemum and Chae rose early to go uphill and dig gravel out of the mine, an old stream bed rich in corundum. They sifted the gravel through water in a fine mesh screen, allowing the denser crystals to sink to the bottom. Then they dumped each screen over onto a table, where the younger children sorted out the crystals. Most of them were clear and not of particular value, but a few were tinted blue, yellow, or even pink; the better ones, when cut, might fetch enough to feed the colony for a week. Even Gaea picked out her share, although most turned out to be quartz.

After the midday meal, Mother Artemis treated and cut the stones, training Haemum on the lap wheel. The younger children painted little dioramas of four-eyes and singing-trees, or strung necklaces of helicoid propeller shells. Rod and Chae worked on the garden, collecting ringed pods and fruits, and replanting the rows gouged out by the visiting tumbleround. In the western field the brokenhearts were ripening fast; how would they ever get them harvested without Patella?

Chae brought back a bushel full of greens to cook up four-eyes stew for the two tables of children, all swinging their feet and twirling the vegetable pods around their fingers. Afterward, as the little ones cleared up, Mother Artemis told Rod, "I sent the Most Reverend Father a neutrinogram." Neutrinos brought word across the space-time folds, resisting the extreme electromagnetic distortions at the connection holes. The signal was crude, never of holographic quality, but it was the fastest way. "I told the Most Reverend Father we need another brother or sister with medical training, at least until Patella returns."

"What will we do in the meantime?" It could be weeks or months before help arrived.

Mother Artemis watched the nightly rain outside, her hair twining into knots and untwining again. "We'll manage. Haemum and Chae will help with the harvest. Between the two of them, now, they bring in as much as Patella did."

Rod frowned, vaguely uneasy. "They are growing up."

LICENSED TO UNZ.ORG
ELECTRONIC REPRODUCTION PROHIBITED

"Exactly." She gave him a questioning look.

"Well—I guess I've been more on the infant end of things here. I'm not sure what the Reverend Father has in mind for the older ones, as they grow into adults."

"When I was a nana in the *shon*, I raised Elysian children for Elysium. Now we raise Prokaryans. They'll grow up to maintain the colony."

"But they're also citizens of the Free Fold." He took a deep breath. "What if they choose to emigrate?"

She considered this. "If the Spirit so calls, so be it."

"But how will they ever know enough? How will they know, without—education?"

"Education is the right of every citizen," said Mother Artemis firmly. "We educate all our children. We meet the standards."

"The formal standards are too low." This was one area where Rod felt a disconcerting gap between human and sentient. "Human education takes years, even decades. We can't just plug in a new module. When I was Haemum's age, my father sent me to the Guard Academy. But it was more than soldiering—it was history, literature, mathematics."

"And your father, was he pleased with the result?"

"He was horrified." By leaving to follow the Spirit, Rod had dashed his father's hopes of continuing the family tradition in the Guard. "That's the point of education: to free a child to make choices that horrify her parents."

"So, should we send Haemum to the Guard?"

"Of course not." Rod shuddered, recalling how many of his worst memories came from there. "For now, she can attend school by holostage. Who knows; she might become a doctor some day. Look at how she set T'kun's arm."

"I know those programs," said Mother Artemis. "The better ones would take up most of her waking hours. But if it's time, so be it." She looked up, and her hair stretched toward him. "Thanks for making the point. You're such a good father, Rod."

Rod looked away, his face warm.

As the children napped or did lessons, Rod checked the holostage to see if he could reach Geode and 'jum, but he found a call waiting. "Return call," he told the holostage.

"Which caller?" the machine replied. It was not particularly intelligent; servo machines were intentionally built to as low a sophistication as possible, to avoid the chance of their "waking up" sentient, in which case they had the right to earn freedom. Construction of dumb servos was a major industry, and was of course anathema to the Sentients Guild.

"Diorite, of Colonial Corundum." Diorite was the shipping agent for Colonial Corundum, a firm that worked commercial deposits in the foothills. His figure appeared on the holostage, tall and lanky, and tanned even darker than Rod. He wore a Valan talar, hung with strings of his pale green namestones, and a wide-brimmed hat for shade. "Rod, you're back," he exclaimed. "I heard about your brother. My sympathies—that ravine's treacherous."

LICENSED TO UNZ.ORG
ELECTRONIC REPRODUCTION PROHIBITED

Rod nodded. "Thanks." He traced a six-point for blessing.

"Why didn't you call me? We could have brought Reverend Mother home, and had your brother up to Station in no time."

That was generous; Rod would never have asked such a favor. "Thanks, I'll remember."

"Any time. Say, I see your old craft's still out there—you'll be shipping back soon?"

"I left six new children at the clinic. Besides, I have a load to ship." There was a sizable cargo of sapphires for Valedon, plus the craft items the children made for tourists.

"You can help us out," said Diorite. "A small package to deliver—the usual terms."

The Spirit Colony was exempt from the costly regulations and reporting requirements for commercial mining. When Diorite had new samples whose contents he did not want known to competitors, he asked Rod to take them up, for a small "donation" which greatly helped the colony. It was legal, and Mother Artemis said they ought to trust good neighbors. "Meet us in the morning," Rod agreed.

"Sure thing. Good luck to your new colonists."

In the morning Haemum and Chae strapped up five of the llamas, a broad-footed breed lifeshaped in the germ line; unlike humans, they could even carry offspring to term on Prokaryon. Strapping them up was tricky, for soon as the beasts felt a heavy load they would empty their guts with streams of spit. Once harnessed, the llamas lumbered dutifully down the trail through the brokenhearts, then turned off into the treacherous wheelgrass with bleats of protest.

The old servo lightcraft was still stuck out in the wheelgrass where Rod had left it. Beside it now sat Diorite's own sleek sentient craft, its rectennas mirror-smooth. Strains of popular music emanated from within, at rather high volume. As Rod approached, the music stopped, and Diorite emerged, shaking his head. "Sorry about that—Dimwit here has limited taste."

"I heard that," called the lightcraft. "Limited taste, indeed. Just you wait—only six point eight months till I draw a salary."

"Sentients," muttered Diorite. "Can't live with the dimwits, and can't live without'em."

Rod smiled. "I'll trade you the llamas any day." Haemum fed a treat to each of the beasts. They stood there, chewing sideways.

"Well, here's the package." Diorite caught Rod's arm, and his voice sank to a whisper. "Just between us Valans—look what we found." He opened his hand beneath Rod's eyes. Between his fingers glinted a ruby, one of the largest and deepest Rod had ever seen. His father had worn such, and so had the Academy Master, whose namestones had glared fire at Rod too often.

A low chuckle escaped Diorite. "There's more where that came from—and *I'm* the only man who knows where."

LICENSED TO UNZ.ORG
ELECTRONIC REPRODUCTION PROHIBITED

Rod smiled. "No Valan will forget his name if you can help it." His own colony's deposit only produced the paler corundum, rarely a fine gem. He stowed Diorite's package carefully in his old lightcraft, while Haemum and Chae helped transfer their crates from the cart. As they worked, Diorite's lightcraft lifted off. The hiss of boiling air shattered the morning calm, startling a flock of helicoids. Upward it soared, then a lateral burst of plasma sent it streaking across the sky.

Haemum said wistfully, "I wish I could come with you."

Rod smoothed her curls and kissed her forehead: only yesterday, she had been Gaea's age. "I could use your help," he admitted, "but the colony's short handed." And now he had to find her a school.

"Will Brother Patella come home?"

"If the Spirit wills. But not for a while."

The old lightcraft soon left Prokaryon behind, the stripes of singing-tree forest and wheelgrass fading into the continent Spirilla where most of the colonists had settled. Spirilla had the shape of an "S," its mountain range rising out of its northern curve, while its southern curve cupped the crater from an asteroid that had collided some hundred million years before. The continent rotated out of view as the great ocean came round, then continents and oceans blurred together, leaving the planet a bright jewel set in the black of space.

At Station, Rod docked and hoisted up his cargo, including Diorite's package. All surfaces had to be cleansed first, by mite-sized servos that removed traces of arsenic and toxic proteins. Afterward, the ship would head off to the first extra-dimensional space fold, where it would "jump" several light-years. Three jumps later, it would reach the star system of Elysium and Valedon. On Valedon, the gems were always in demand for namestones. The crafts would sell better on Elysium, whose millennial inhabitants in their floating cities admired anything handmade.

While the cargo was processed, Rod hurried off to the clinic. He found Geode feeding two infants while changing a third.

"Brother, am I glad to see you." Geode's eye stalks twined in delight, and he extended his furry red arm around Rod. "You would be quite worn out with those little ones. Even I need an extra recharge."

"You've done well, I see." Rod picked up the youngest girl, T'kela. Less than a week old when he first picked her up in Reyo, she still fit comfortably in one hand. Her own wrinkled hands squirmed at odd angles, and her face had a preternaturally wizened look. She stared at Rod's face, then fell asleep, her arms still sticking out straight from the blanket. Rod put her up to his shoulder. The magic of such a tiny person always took him by surprise, as if it were the first time.

The two older ones were crawling and pulling themselves up to stand. Now that they were well fed, they acted more like toddlers than the infants the orphanage had claimed. That could mean extra costs for lifeshap-

LICENSED TO UNZ.ORG
ELECTRONIC REPRODUCTION PROHIBITED

ing—one "older child" was bad enough.

'jum was at the holostage, observing a stellated geometric solid that hovered insubstantially before her. She caught sight of Rod and stared, then came over and squeezed his hand, digging in with her fingers as if to assure herself he was really there. Her face glowed with health, her cheeks already filling out so that he might barely have known her. Rod imagined the millions of nanoservos swarming through her veins, to clear her prions and give her genes for Prokaryon.

"Hello, 'jum," said Rod. "Found any interesting numbers lately?"

The girl only stared.

"Don't let her fool you," said Geode. "She can talk, all right. Say, 'jum, did you count the corners on that solid yet?"

'jum swallowed to speak. "Twelve corners pointing out, eighty pointing in. And one hundred eighty faces."

Geode groaned. "You've got the algorithm, all right. Hey you," he called to the holostage, "show us an extra dimension, will you."

"Please specify request," the holostage replied in a flat tone.

"A four-dimensional geometric solid, Dimwit."

Rod frowned. "Brother, don't talk like the miners."

"You're right," Geode replied contritely, hunching his arms. "Let us pray for mindless machines, that they be granted souls. Well, the babies are making excellent time," he told Rod. "The youngest one is taking up nanoservos twice as fast as usual. All her cells are making arsenate pumps, and her liver is nearly transformed. She'll be home within two weeks. I show them your holo image, and Mother Artemis, as often as possible," said Geode, "so they'll know you well. I show them Patella, too; I sure hope he gets home soon." His eyestalks twined anxiously.

"What will we do without him?" Rod asked softly.

"Pray. Pray without ceasing."

Rod picked the toddler Qumum up from the floor and tried to catch his gaze. After a minute Qumum suddenly smiled, a big smile with his mouth and eyes wide. Then he let out his breath with a trill. Rod laughed. "Here's someone happy. Say, 'jum, how about you? Do you like your new room at Station?" Station would be her home for some months, perhaps longer.

'jum nodded, then looked away with a guarded expression.

"I'm sure you miss the blue sky." Among other things.

'jum looked up suddenly. "Does the creeping ever reach the Children Star?"

Rod crouched to look into her face, catching her shoulders. "Never, 'jum. You will never be sick like that again."

"There's one good thing about Prokaryon," Geode reflected. "None of their little creepy-crawlies can grow inside human bodies and make you sick. You're as toxic to them as they are to you."

Rod departed at last, and checked that his cargo passed inspection. An hour remained for his one indul-

LICENSED TO UNZ.ORG
ELECTRONIC REPRODUCTION PROHIBITED

gence: supper at the Station lounge. It was a rare chance to be surrounded by adult humans again, although he had little in common with the staff and did not know anyone well.

The lounge was built Elysian style, with rounded nooks that could expand or contract, and tables of nanoplast that shaped themselves to accommodate those who sat there. There was even a tree full of butterflies at the center, for Elysians to meditate. But most importantly, the tables actually served differentiated food. It was all synthetic, of course, like the packets Rod's instrument produced for his meals at the colony, but Station's model could synthesize a thousand different food items, from filet of beef to flying fish.

First he had to find a seat. The bubble-shaped dining compartments seemed more crowded than usual with miners, surveyors, and researchers. Even two or three news reporters hovered overhead, shaped like snake eggs; some odd rumor must be up. Usually one of the nanoplastic walls would notice Rod and tunnel in to create a new space, but not today. Perhaps the dining hall had reached its volume limit. He paused uncertainly, brushing a whirr off his arm. The few that strayed out to Station seemed less picky about sustenance than those back home.

He saw a hand waving, next to an empty seat. The stranger motioned him to sit, removing her backpack from the chair across from her.

"Thanks," he said. The woman, a simian student, looked vaguely familiar.

Rod sat down and placed his finger on a small window that read his fingerprint. Choosing what to order was always hard, all the more so since every minute that passed made him feel acutely guilty for keeping himself from the colony. "Shepherd's pie, with mixed greens." He usually ended up with his Valan home favorite.

The woman opened a pocket holostage to play news. Rod never watched the news, as it distracted from his prayers. Today's news was about Prokaryon's "hidden masters." Giant tracks had appeared among the singing-trees, in a remote region west of Mount Helicon. Even on the holostage the "tracks" looked more like stream bed erosion, but of course there were experts to claim otherwise. No wonder the "snake eggs" were about.

The tabletop opened, and a plate of steaming pie rose up. The odors brought him right back to his childhood; he could almost hear the gulls calling off Trollbone Point. The pleasure of the first few mouthfuls filled his attention, until the holostage again caught his eye. Another ship of illegals from L'li had tried to crash land, this time on Elysium.

The hapless vessel hung forlornly above the Sharer ocean, in which the Elysian cities floated. Elysians had intercepted it, of course, and repatriated the passengers. Rod's fork froze in his hand.

The woman was watching him. "You came from L'li, didn't you?"

He recalled the simian student in

LICENSED TO UNZ.ORG
ELECTRONIC REPRODUCTION PROHIBITED

the connector tube, staring down at him as he tried to keep a grip on the infants.

She closed the holostage and extended her hand. "I'm Khral, a microbiologist, just arrived from Science Park." Science Park, the top Elysian research institute, sponsored field work on Prokaryon. "I've joined the singing-tree project."

"Welcome," said Rod, shaking her hand. "I'm Brother Rhodonite, of the Sacred Order of the Spirit."

"Oh yes! I've heard of Spirit Callers on Valedon. They do a ritual dance before the moon at midsummer."

"That's the 'Spirit *Brethren,*'" Rod corrected, much annoyed. "They split off years ago."

"I'm so sorry, I don't know much about Valedon. I'm from Bronze Sky." Bronze Sky, named for its vulcanic haze, had been terraformed four centuries before to settle excess L'liites. Today Bronze Sky was full, and there were twice as many L'liites as before—and Prokaryon was here to settle.

But Khral also showed ancestry from gorilla hybrids created as slaves on ancient Urulan. Her nose was pushed in with a wrinkle, and her heavy brow overhung her eyes, giving her a permanently serious expression. "You know, everyone gets wrong what I do, too. The students here avoid me. They think I'm here to find a plague, to give the Fold an excuse to terraform Prokaryon. But it's not true."

"It doesn't make sense," agreed Rod. "Prokaryan microbes cannot live in humans."

Khral looked thoughtful. "That's an interesting question. There are reports of occasional microzoöids isolated from human tissues—and even from nanoplast."

"Microzoöids?"

"We call Prokaryan microbes 'microzoöids' because each cell is doughnut-shaped, just like the larger zoöids. The cell runs its circular chromosome right around the donut hole! With their triplex DNA, microzoöids reproduce by splitting three ways down the middle, into three daughter cells."

"But they can't reproduce in humans. We're too . . . foreign." He realized he knew nothing about it, only what the clinic had always told him.

"That's right," Khral agreed. "The few microzoöids found in humans never grow in culture. But if they could exist for any length of time, just long enough to divide and copy their DNA, you're bound to get mutants. And some day those mutants—"

"Let's pray they don't," Rod exclaimed. "The last thing we need is an epidemic, with our doctor away."

Khral laughed, and her large teeth showed, yet somehow she looked more human. "Never fear. Even our own microbes are mostly harmless, after all; they get a bad rap. But you shouldn't be without a doctor. Doesn't Station cover you?"

"Sure, but they can take days to show up. The mining camps offer a thousand acres to recruit doctors—we can't match that. Patella came because he is a Spirit. But he just had an accident. . . . " He stopped himself. "We'll manage. There's a lifeshaper on Mount Anaeon that we can call."

LICENSED TO UNZ.ORG
ELECTRONIC REPRODUCTION PROHIBITED

"A lifeshaper? You don't mean the Sharer, Sarai?"

"You know her?"

"I'm trying to meet her. She's one of the few people with data on microzoöids, most of it unpublished. She hasn't returned my call yet."

That was no surprise. "Sarai keeps to herself."

"I would have lots to offer her—the latest strains and methods from Science Park."

"If you're not here to find a plague, what are you here for?" Rod asked.

"I told you—the singing-trees. Singing-trees are full of microzoöids."

"They don't look sick to me."

"Neither do you—and your body carries ten times as many bacteria as human cells."

Not exactly a comforting thought.

"And we exchange bacteria all the time, no matter how much we wash our hands. You can track the same bacteria strains in a family—in mom and dad, kids, even the family dog. You could say we 'communicate' through our bacteria." She grinned excitedly. "That's my theory: The singing-trees communicate by exchanging microzoöids. That's why nobody's made contact with them yet: *Nobody's looked at their microzoöids.*"

So that was it, Rod thought, leaning back from the table. Yet another scheme to reveal the "hidden masters."

"Station's been pushing singing-trees for years," he told her. "They've little to show for it."

"It's different this time; we're really onto something. That's why I'm here."

Rod regarded her curiously. "Why are you scientists so anxious to find some high-IQ creature running Prokaryon? Why can't you just let it be? If someone is in charge, they'll show themselves once we prove worthy of their notice."

"That's just the point—how do we get them to notice? If they've mainly studied our bacteria output ever since we got here, they must think we're pretty dumb."

That was hard to deny.

"I should think you'd be interested," said Khral. "Without that last bit of doubt about 'hidden masters,' how long before we humans would blast Prokaryon open?"

Rod thought of the moon glowing red and shrinking every year. A sense of unease crept up his neck. "The Secretary of the Free Fold would never allow that."

"The Secretary's mate is the president of Bank Helicon. Elysian banks don't like ships of illegals. Bank Helicon wants to get Prokaryon developed—now, not centuries from now."

He would have to run to make his launch time, he realized suddenly. His finger tapped the window; the plates descended as he got up, and a nanobug cleared the crumbs. "We will pray for the president of Bank Helicon."

Chapter 4

On returning to the colony, Rod distributed a bag of sweets from the lounge. The children crowded around, then all but the twins and Gaea went off to the sapphire mine. Mother Artemis nursed the twins from two of her breasts, while Rod mended a strap

LICENSED TO UNZ.ORG
ELECTRONIC REPRODUCTION PROHIBITED

of a llama's harness, and tried not to let his foot go to sleep in Gaea's grasp. "Is it true," he asked the Reverend Mother, "that the Elysians want to terraform Prokaryon?"

"Some do," she said. "So few humans can live here."

"So they want to fill our colonies faster." He pulled the heavy needle through the thick tumbleround hide. He never had the heart to kill a tumbleround, but one that had died naturally provided enough cured hide for a year's worth of shoes and harness straps.

"The Sharers won't allow terraforming." The native Sharers had dwelt in Elysium's ocean, long before the Elysians built their cities. "They have Elysium in their power. Their lifeshapers could easily make all the floating cities uninhabitable."

Rod thought this over. "But it's not up to Elysium. The Free Fold—other worlds could vote to repeal the ban."

"Secretary Verid will never allow it." The Reverend Mother spoke with confidence, for she had once worked closely with the Elysian leader Verid Anaeas*bon*, years before during the early sentient uprisings. Now Verid was Secretary of the Fold Council.

Pima and Pomu were scrambling down from the Reverend Mother's lap. On her skirt a bear came alive and made faces at them; they hurried over to watch and laugh. The laughter of children was worth more than gold.

"For Haemum, I've checked out the New Reyo Branch of the Interworld Free School," Mother Artemis told him. "Would it meet your requirements?"

"It's a good start." New Reyo was a larger L'liite colony on another continent, where the farming was better. The Spirit Callers had received a cheaper tract in Spirilla.

"She can enroll at any time. We'll let her try it out and see." There was a prayer answered. Mother Artemis added, "I've also been thinking of T'kun's arm. We need to have it checked, to make sure the bone is healing straight." She paused. "We'll have to call Sarai."

Rod tensed inwardly, but if the Reverend Mother had decided, so be it.

Their first attempted call produced a stall of spattering light on the holostage. Perhaps Sarai had jinxed her connection again, to ward off offending callers. But after a few minutes, the connection held. The Sharer lifeshaper emerged from the surrounding vines of enzyme secretors and other leafy assistants. Her skin was smooth, hairless, and purple all over, from the symbiotic breathmicrobes that stored oxygen for swimming. The effect was especially striking since, according to the custom of her aquatic race, she wore no clothes.

"You share good timing, Sister." Sarai's webbed hand held up a large pear-shaped pod, one of the living instruments of her lifeshaping. "You're just in time to see me commit genocide."

"Good evening, Sarai," said Mother Artemis, ignoring her remark. "My deep apologies for disrupting your work. Please help us. Brother Patella had a mishap and had to leave us, and now one of our chil-

LICENSED TO UNZ.ORG
ELECTRONIC REPRODUCTION PROHIBITED

dren needs attention. If ever we can return assistance . . . "

Sarai plunged the pod into a vat of liquid. "There—a billion microzoöids meet their death, that I may study their chromosomes. Who will sing their deathsong?"

"The Spirit Callers built a shrine for microbes," Mother Artemis told her. "For all the microbes killed in the name of science."

Sarai laughed. "I should have known." She waved her hand, snapping her fingerwebs. "What's your problem?"

Mother Artemis described the accident, and the boy's condition.

Sarai listened for a while. "Enough," she interrupted. "Bring him up tomorrow, and I'll see him. Remember, if I'm in whitetrance, leave me alone." The holostage went blank.

"That's Sarai," said Mother Artemis. "Once she sees the boy, she'll treat him. And Sharers never take payment." She turned to Rod. "What shape is the lightcraft in?"

To land safely on a mountain? No way." The realization sunk in. He would have to travel a day down the zoöid-infested plain accompanied by a four-year-old with a broken arm, then cross a band of singing-tree forest, then hike another day up the glacial cliffs of Mount Anaeon, to reach the hanging valley where Sarai lived. Rod swallowed. "Are you sure you can manage here on your own?"

"We'll manage. You could bring Gaea, too, you know; Patella and I were discussing it. It's high time we fixed her spinal cord." She paused. "It can't hurt to ask."

* * *

Rod was up at dawn to harness the llamas for the journey. Haemum had already fed them, as they groaned toward the rising sun. She packed their provisions, pulling the straps tight and gave one beast a pat on the side. The llama's head swayed on its long neck, its mouth a perpetual grin. Haemum looked longingly across at Rod. "I wish I could go with you."

He clasped her shoulders. "Haemum, today you will journey much farther than Mount Anaeon. You'll enroll in the New Reyo School. You'll visit times and places none of us have ever seen."

Instead of Haemum, Chae would come along to help T'kun, while Rod managed Gaea. The two boys appeared, having dressed and fed themselves. T'kun was still half asleep with his thumb in his mouth, his arm in a fresh sling. Chae would ride one llama with T'kun behind him, while Rod rode the other with Gaea strapped to his back. Gaea was the last to be wakened, changed and fed. The little girl beamed and clapped her hands at the sight of the llama. "Gaea go ride. Go ride, see zoöids."

Rod shuddered, silently calling the Spirit to keep zoöids out of the way. At least the girl was starting out on her best behavior, for nothing pleased her more than to ride with her favorite parent all day.

"Here," said Mother Artemis, giving him a map cube. "Even if the trail goes bad, you can't lose your way."

Their hands each traced the starsign, the invisible stars evaporating yet they lingered in Rod's heart. The

LICENSED TO UNZ.ORG
ELECTRONIC REPRODUCTION PROHIBITED

llamas set off and paced down the trail into the wheelgrass, to the east, the opposite direction from where the craft from Station usually landed. Their outsized feet made good time on the trail.

The air was still and clear; the distant singing-trees had not yet awoken, and the helicoids were just beginning to stir. A herd of a dozen four-eyes grazed peacefully to the east, each shape casting a long shadow back from the rising sun. The two eyes awake on top were faceted like rubies. Now and then one of the creatures rolled forward on its suction pads, extending the next of its four hungry mouths. At Rod's back, Gaea stirred and stretched. "Zoöids," she called softly.

Rod pulled the rope and called to Chae. "If anything big comes along, remember to *freeze*." Humans neither looked nor smelled like food—unless they ran.

The llamas soon reached the shore of Fork River, so named because upstream the three major tributaries from the mountains met and fed into it. The water rolled wide and lazy, barely rippling through the loopleaves that drooped over the side from bushes at the edge. A long, dark hydrazoöid undulated beneath the ripples; its body was a torus extended into a tube. Its long fin spiraled around its girth, and it swam like a corkscrew.

Rod paused, recalling the last time he had ridden up into the mountains, some five years before. It was easy to follow the river upstream. But the trail was less well kept here, and the river cut across several bands of singing-tree forest. He waited for Chae to catch up. Behind him Gaea stirred and stretched. "How are you getting on?" he called back to Chae.

"Just fine." Chae traced a starsign.

From behind the ten-year-old, T'kun leaned outward and craned his neck forward. "Are we there yet?"

"Don't be a baby," said Chae. "We've barely started yet."

They continued east, along the bank of the lazy river to their right. The mountains now rose straight ahead, their fog melting away, and the peak of Mount Aneaon stood clear. On the trail, wheelgrass had grown up in patches, the tall elastic double-stems sprouting loopleaves, each of which was a snare. The llamas picked their legs straight up and down, but still they would get their hooves caught. No wonder few Prokaryan creatures had evolved projecting limbs. Once Rod caught sight of one whirr-clouded tumbleround, a fairly large one with its long tendrils stretched at all angles to the ground, like a discarded tire covered with cobwebs. Though harmless, somehow the sight of one always made Rod's hair stand on end.

The hollow voice of the singing-trees arose now, in waves that grew and quieted again. The tones deepened, reverberating even through the ground below. Ahead of the travelers the dense band of forest emerged and grew, resolving into deep violet singing-trees. The singing-trees rose in enormous arches, several times taller than the colony dwellings. The lower sector, between each pair of "trunks" in the arch, dipped into the ground to

LICENSED TO UNZ.ORG
ELECTRONIC REPRODUCTION PROHIBITED

thrust double-roots deep in the soil. From the top branched multiple arches, sprouting loopleaves. The uppermost arches were flattened into stiff plates narrowly spaced together; these vibrated at the slightest hint of wind, "singing."

As the llamas entered the forest, the air cooled markedly, and the path lay free of wheelgrass. The upper canopy cut off most of the light, except for occasional shafts from above as if through a window. The dark arches gave the atmosphere of a temple; one could well believe the planet's rulers dwelt here. As the wind lessened and the songs quieted, smaller zoöids could be heard rustling unseen. The river brooded beside them, furtive creatures slipping into its depths.

Rod decided to stop for water. The llamas waded into the river, while he filtered some for the children. Out of the corner of his eye Rod saw something fall from a singing-tree. A little shriek broke the calm, followed by scuffling sounds. The shriek repeated, fading slowly. Curious, Rod took a step forward to look beyond through the arch of the tree. A hoopsnake had caught a smaller zoöid in its loop, then twisted into a figure eight to strangle it. It might take a while, especially if the prey had four lung systems, as a four-eyes did. But in the end the hoopsnake would have a meal to suck the juice from.

Chae came over and caught Rod's hand. "Brother Rod, shouldn't we help it?"

He meant the little one, Rod realized. "That's nature, Chae. You wouldn't want the whole forest overrun with zoöids." He scanned the canopy, wondering what larger denizens might perhaps take aim at them. But only another hoopsnake wound itself along a branch.

As they rode deeper into the forest, the singing-trees grew larger and their voices swelled till they drowned his own. At one point the trail headed straight under the arch of a giant, perhaps a thousand years old. Were the "masters" really watching, as Khral had said? If so they gave no sign. At last the trees thinned out again, and the ground became more sodden, full of stagnant pools covered with slimy growth, as well as oddly flattened helicoids that whirled along the surface.

The travelers emerged into the next band of wheelgrass. Blinking in the sun, Rod scanned the horizon. Mount Anaeon rose larger than before; but just ahead, the wheelgrass was full of four-eyes. Hundreds of the creatures pressed together at the riverside. These four-eyes were blue and brown striped, and much larger than the breed he saw close to home.

"We don't want to get caught in that herd," he told Chae. "We'll have to detour." Reluctantly he turned away from the river, hoping to get around the herd without losing too much time. There were four-eyes of every age, including paler young ones, and parents with a baby firmly seated in the inner hole, where it would feed on special polyps that grew on the parent's hide. One pair were actually coupling together, like two stacked donuts, each extending its germ cell donors into the receptacles of the other.

LICENSED TO UNZ.ORG
ELECTRONIC REPRODUCTION PROHIBITED

The travelers were coming around the herd when a commotion erupted, nearer the river. The four-eyes started to roll, forward in one direction, then suddenly backward. Back and forth they zigzagged, the wheelgrass springing up behind them, their pungent alarm hormones filling the air.

From across the plain rolled a megazoöid, one of the largest that Rod had ever seen; twice his height, he guessed, perhaps twenty times his weight. Four-eyes scattered before it, except for the unlucky ones who ended up in the giant's path. Two more of the megazoöids appeared, surprisingly fast once they gathered momentum. They seemed to be trying to trap the four-eyes by the river.

"Watch out!" shouted Chae behind him.

"Freeze!" The boy pulled his mount to stop.

In that instant Rod realized that he had told Chae to do absolutely the worst thing. He pulled his own mount around and rode back to the boy. *"Run for it,"* he shouted. *"Or the herd will run us down."* He slapped Chae's llama on the rump and sent him pacing, and prayed that T'kun could hold on. Then he followed, dodging the frantic four-eyes that already were charging into their path. His own llama stumbled once in the loopleaves. The dust and the powerful scent had him choking and his eyes streaming. Rod thought he would never get out alive.

At last he broke free of the herd. Ahead rose the next band of singing-trees. But where were Chae and T'kun? For a few agonizing minutes, he was convinced the boys lay trampled beneath the stampeding four-eyes. Then he saw the llama, standing still, with one rider.

In an instant he was at their side. Chae was seated on the llama, dazed, while T'kun lay on the ground crying where he must have fallen off. Rod helped him up and checked out the little boy's limbs as best he could.

"You said to freeze," Chae whimpered.

"I was wrong. But you did well, Chae." Rod inspected T'kun's cast, which was intact. "You saved your brother's life."

"I want to go home now."

Soon Gaea's wailing joined the chorus.

In the distance, several giant megazoöids gathered to suck the guts out of all the squashed four-eyes. One of the giants had an offspring attached snugly inside its donut hole, eating the polyps off its parent.

The travelers at last camped for the night at the edge of the singing-trees, by the river. Rod pulled a piece of solar nanoplast off his pack where it had charged all day, then he gathered it into a lump and set it glowing. Chae caught a hydrazoöid to fry; Rod thought it looked and smelled like a rubber hose, but the children devoured it. Far above in the canopy, light flashes streaked between the luminescent loopleaves in hues of yellow, green, and blue. The light show, even more than the "singing" of the singing-trees, attracted scientists in search of hidden masters.

Rod set out a nanoplastic tent stick,

LICENSED TO UNZ.ORG
ELECTRONIC REPRODUCTION PROHIBITED

which promptly shaped itself into a shelter. Already the nightly drizzle was falling. The wind came up, and the trees keened so loudly that he thought he would never sleep. But he was dead tired, and, with his arms across the three of them, the night passed.

He awoke to hear Chae screaming once again. "*Megazoöid!* We're trapped!"

Still half asleep, Rod tried to extricate himself from his sleeping bag. His limbs were sore from the hard ground, and besides there were long filaments of some sort stretched out like a curtain over him and the children. He yanked the filaments out and tried to stand. The smell of glue was overpowering, and whirrs buzzed deafeningly around his head. Something huge towered over him—

It was not a megazoöid. It was a tumbleround. There was no mistaking its filaments and the whirrs swarming over its stinking hide.

Rod lost no time extricating the children and as much of their camping gear as they could salvage. The llamas remained tethered nearby, feeding placidly as if the commotion was nothing to them. The tumbleround itself made no sound nor rapid movement. It had no eyes, nor ears; so the scientists said. It must have been rooted nearby, near enough to gradually migrate over during the night. But why? Did it need some essential nutrient from the human bodies? Or did it seek something deeper?

"Who are you?" Rod demanded aloud. "What do you want from us?" Hearing himself, he felt foolish. But it was odd how the tumbleround had migrated exactly to the point where the human travelers lay—and no farther. It could have crushed them, or sucked them dry, but instead all it wanted was . . . a touch? A look in at the window?

They saddled the llamas, Rod taking one last look backward at their nocturnal visitor. Perhaps Sarai might know more about tumblerounds.

Now the trail grew much steeper, for this stretch of forest extended onto the foot of Mount Anaeon, where the bands of "controlled" habitat at last gave out. Here was where the true wilderness began; where even the weather might be unpredictable, where flora and fauna seemed to obey no master save the creator of the universe.

The travelers approached the fork of Fork River, where Mother Artemis's holographic map led them up the steepest of the three tributaries. Now the water was rushing swiftly, gurgling, eddying around stones worn smooth. The trail continued along the left bank, rising ever higher above the stream itself. There stretched a vast U-shaped valley between Mount Anaeon and Mount Helicon, carved by a long departed glacier. Now the valley grew singing-trees even taller than those on the plain. The rising mountainside became so steep that to the right Rod looked down upon the tops of the singing-trees, while to the left, where the trailblazers had blasted through, the root systems of trees were exposed, their double-roots clinging to rocks about to fall at any moment. From far below in the valley the roar of the stream echoed upward.

LICENSED TO UNZ.ORG
ELECTRONIC REPRODUCTION PROHIBITED

Then the singing-trees shrank and thinned out, replaced by bushes of tough loopleaves, full of scarlet and golden flowers that cascaded hundreds of meters down toward the river. Above jutted rocks like the teeth of dead giants. At one point the rocks had broken and slid down onto the trail, where the llamas had to pick their way painfully across. The sun was rising, but the air grew cold. On the cliffs above clung diamond-shaped patches of snow.

A bend around the mountain, and there it was: the waterfall. Millions of tongues of foam falling, falling forever to the Fork River tributary below, from a hanging valley cut off by the ancient glacier. The waters roared on, sending billows of mist upward. Above the falls piled layers of stone, up to the snow-covered peaks.

Rod's map box chirped at him. Inside the box, the bright line took a turn off the trail, somewhere near here. Sure enough, there appeared a footpath, half overgrown with bushes that made wheelgrass seem like a paved road. Undaunted, the travelers took the side path, heading down toward the midst of the waterfall.

Now he remembered. There would be a hole in the mountain, an opening to a tunnel behind the waterfall which powered Sarai's laboratory. "It's all right, keep up," he urged Chae, who hung back, reluctant to get soaked in the mist from the falls.

Rod dismounted, and bade Chae do likewise while they felt their way. At their left, they met sudden darkness.

An invisible cavity opened. The llamas stumbled into the dark, whining in complaint. Gaea whimpered, and Rod took her out of the pack to comfort her. As his eyes adjusted, patches of green light glimmered, revealing a low ceiling. They were plants that glowed in the dark, plants with real leaves—Sharer plants.

A large long-legged insect swirled about their heads, making a clicking noise. It was a clickfly. The Sharer insect veered back down the tunnel, whose ceiling bristled with dog-tooth calcite crystals as big as Rod's thumb. "It's a messenger," Rod told Chae. "Let's follow it."

Suddenly the cavern filled with light.

"Messenger indeed." Sarai appeared, several clickflies perched on her scalp and arms. Smoothly purple from head to toe, she had not a stitch on; Rod felt embarrassed, for he had forgotten to warn the children. But Sharers somehow look clothed enough as they are. Sarai added, "I've had reports of you for the past half hour, driving those miserable beasts of yours across the rocks."

Rod sketched a star. "Thanks so much for seeing us." He introduced the children. "T'kun is the one you need to see. We are forever in your debt."

Sarai flexed her fingerwebs, and a clickfly flew off. "Bother all that." She eyed him sharply. "It's the one in your arms I need to see. What lamentable shape she's in. Child abuse."

Rod held Gaea tighter. "She needs help too," he admitted.

Sarai turned and headed down the tunnel. "I don't know," she muttered, "I just don't know about you clerics.

LICENSED TO UNZ.ORG
ELECTRONIC REPRODUCTION PROHIBITED

Raising children you can't afford." Her scalp had a fine down of hair, suggesting a Valan ancestor back a generation or two. She led them to chamber full of tangled vines, like a greenhouse. She gestured to T'kun to sit here, and Gaea there. The vines snaked over and twined around each of them unnervingly; undomesticated varieties could be carnivorous.

Rod patted their shoulders gently. "Sit very still." These vines, lifeshaped for their task, would sample minute traces of their tissues and body fluids. The children kept still, as if awed by their strange surroundings, their wide eyes casting around them.

Sarai flicked her webbed hand at Chae, and she pointed to a bowl of fruit. "Eat something; you're too small for your age."

The messenger insect hovered above T'kun, watching. It nestled amongst the vines for a while, then it went to the ceiling, where it started to weave an intricate web. Sarai watched the web intently as it grew.

"The boy is full of bruises," Sarai announced. "What have you done to him?"

Rod's hands clenched. "The journey is not easy, as you know. He could only hold on with one arm."

"His bone is fine," she announced. "The bruises will also be fine."

Rod let out a long sigh. "Thanks so much. We won't trouble you any further."

"The girl will take me longer."

He blinked. "You mean—you can help her?"

Sarai fed a bit of what smelled like fish to her vines. "She needs to regenerate her spinal cord." Sarai nodded toward a particularly large vine straggling over the wall, whose blooms spanned the length of his arm. "She'll hatch from the bud in about a month."

His heart overflowed with hope, then turned cold. He watched Gaea, as Sarai's meaning sunk in. Gaea must have sensed it, for suddenly she pulled out the vines and dragged herself over the floor to his feet.

"A month . . . here?" he repeated. "Inside a . . . flower?" Of a carniverous plant? He wanted to snatch the child back.

"From the chest down. Well, what do you want? Why didn't you get her here sooner? Machines and ignorant clerics, raising infants—there ought to be a law."

"You didn't answer our calls," Rod snapped. "What do you know of children, holed up alone on this damned mountain?"

"Bro-der Rod," Gaea's voice quavered. "Gaea go home now."

Sarai was chuckling as she rearranged her scattered vines. "So the Spirit Caller has a temper. Well, well. Should I treat every impoverished infant in the Fold? Even my Sharer sisters let the Elysians drag the L'liite ships off *Shora*," she observed, using the ancient Sharer word for their home world.

"Better one than none." Rod took Gaea up in his arms. *This ocean has no shore . . . the Spirit should grant me a world.*

"Let them come here, then," said Sarai. "Let them find me."

"They try. A new student from Science Park tried to reach you."

LICENSED TO UNZ.ORG
ELECTRONIC REPRODUCTION PROHIBITED

"'Hidden masters' again," she replied with contempt. "They call themselves scientists, yet all they want to prove is that some great father rules the world after all."

"Do you think the singing-trees communicate?" he asked suddenly. "What about tumblerounds?"

Sarai froze still. Her inner eyelids came down like pearls. They protected Sharers' eyes underwater, but Sarai used them to hide her inner thoughts. "Why should I share my data?"

"Go home now," insisted Gaea.

Rod held the child tight, sickened by what he had to do. "Gaea, you'll have new legs when you come home."

Chapter 5

The return journey was easier, yet infinitely harder, for he could only wonder how Gaea fared after her last shrieking farewell. At home, Mother Artemis assured him that he had done the right thing. "I knew Sarai would help," said Mother Artemis, "once she saw the dear little girl in front of her. When the Spirit offers, do not question."

He still felt sick to think of it.

Haemum, now, was brimming with excitement at her new school. "There are all kinds of worlds to see!" she exclaimed, as they pulled out double-root weeds that clung like steel wire. "You can dive right into the ocean, or climb to the top of a volcano on Bronze Sky—the ground shakes when it erupts. You can learn how all the planets were made, how the rock flows under and over inside them. Some of them even have 'weather' that changes every day—did you know it can rain in the daytime? And then you can see a *rainbow* stretch across the sky!"

"Imagine—a rainbow." Rod looked up from the garden with a smile. There was nothing like the magic of a young persons's first taste of the world.

"You can meet Fold Friends, too." Haemum had brushed her curls neatly, and her voice had a new lilt in it. "Even Elysian children in their fabulous nursery; and you can send them neutrinograms! Our little ones should have more lessons, you know. Children belong in school eight hours a day."

"*We'll see about that.*" Some of the New Reyo colonists had extreme ideas. Mother Artemis's lessons were more efficient than the school days he recalled. "What time in the morning are you due in class?"

"Our homeroom starts at seven."

"Let's head out at dawn, then, to bag some four-eyes before school. Our meat supply is getting low."

In the morning, as the sun peeked out between Mount Helicon and Mount Anaeon, Rod and Haemum rode south through the brokenhearts to hunt four-eyes. Bullets were little use against zoöids; a four-eyes shot in one stomach would simply roll off and make do with three. Megazoöids did the same, as early explorers had learned the hard way. Lasers worked better, for a zoöid sliced clean through was stopped in its tracks. But lasers could start a fire, inducing a Prokaryan storm to put it out. How

LICENSED TO UNZ.ORG
ELECTRONIC REPRODUCTION PROHIBITED

the planet managed this, no one knew.

What worked best was poison. Because Prokaryan biochemistry was so alien, a poison dart that killed four-eyes had no effect on humans consuming the meat. So Rod and Haemum rode up slowly toward the herd, singling out stragglers. Silently he mouthed a prayer to the spirits of the creatures whose bodies would give them food.

The four-eyes did not seem to recognize humans as a threat, either by sight or by smell, and appeared too stupid to learn. Not high on the list of candidates for "masters," Rod thought as he aimed his dart gun.

The zoöid rolled off immediately, then zigzagged twice. Within a minute, it wobbled and fell. Rod and Haemum picked off half a dozen thus, then dragged the bodies some distance away to prevent the herd from running them over. By then the stomachs of the dead zoöids had emptied out, a last reflex. The air filled with a smell worse than skunk. It did make them easier to clean later, Rod thought as he hoisted the carcasses onto the backs of the llamas.

The rest of the morning Rod spent at the gravel pit with Pima and Pomu, training them to sort sapphires. When they returned, Diorite was at the door with Mother Artemis. He made the starsign for Rod. "Good to see you, Brother. As I told the Reverend Mother, I've brought a helping hand for your harvest."

Beside him stood an earth digging machine. "He's called Feldspar, and he's a loyal member of our crew. He could use a break from us, though; most of our crew are a hard-living lot, whereas Feldspar likes to read ancient literature and watch plants grow. His nanoplast reshapes for threshing and harvesting. He doesn't care for human speech, but he'll do the job."

"Feldspar says he's very happy to be here," Mother Artemis agreed. "What a lovely idea, Diorite; you've certainly made miracles come true. And we'll be glad to confirm your tax writeoff."

"Thanks, Diorite." Rod was taken aback, for they had never accepted quite so great a favor before.

"It's our pleasure," the miner said. "After all, Spirit Callers bring good luck."

"I hope your business is doing well."

"Actually, we could use all the luck we can get just now." Diorite wiped his face with his hand. "The takeover, you know."

Rod never quite kept straight who owned which of the mining firms. "I thought you were already a division of Hyalite Nanotech."

Diorite's eyes widened. "Didn't you hear? Hyalite itself just got taken over."

"By whom?"

"Proteus."

Proteus Unlimited. Even Rod had heard of Proteus Unlimited, a servo firm that doubled in sales every year.

"Is that so bad?"

"Is that *bad?*" Diorite's voice fell to a whisper. "Proteus Unlimited makes sentient-proof servos. They invented a training process that keeps servos asleep forever, even giant ones the

LICENSED TO UNZ.ORG
ELECTRONIC REPRODUCTION PROHIBITED

size of a small moon. Imagine it: a moon at your beck and call."

"I can imagine."

"An Elysian runs the firm, Nibur Letheshon. When Nibur buys a new company, it doesn't just keep humming; it gets swallowed up into Proteus, all its operations redirected to make servos. Most of Hyalite makes servos already; the old-fashioned kind that can "wake up" and buy their way out. But no more. All Nibur will want of my division is the mining rights to sites rich in lanthanides. You'll see."

Rod doubted it would make much difference to the Spirit Colony which firms traded what, but for Diorite's sake he hoped things turned out better.

After Diorite had left, Mother Artemis said, "We have word from the Reverend Father. I saved the neutrinogram."

The image quality of a neutrinogram was limited to a snowy monochrome in two dimensions. But at least it came fast, its transit time limited to the sum of the real-space distances from each space hole to the next. The snow coalesced into a hooded face with a long gray beard. It was the Most Reverend Father of Dolomoth.

"The Spirit be with you, Reverend Mother Artemis, Brother Geode, and Brother Rhodonite," said the Most Reverend Father. "All our sympathy pours out for you, on the occasion of Brother Patella's misfortune. We call on the Spirit to make Brother Patella whole again, and to give you all strength in your sacred mission. As you know, Brothers and Sisters, the ways of the Spirit are infinitely mysterious, even to those of us who have called for many decades. Our hearts move for you. And yet, hard as our mortal spirits cry out, it would seem that all of our brethren at present are called upon elsewhere. Be sure that we will hold you up to the Spirit in our hearts, inspired by your selfless mission. . . . " The message ended, fading into snow.

Rod listened closely. He turned to the Reverend Mother, who would obey the Reverend Father, just as Rod obeyed her. Outward obedience brought spiritual freedom.

In this case, however, it sounded like the Reverend Father had no one else to send; and their instruction was unclear. Mother Artemis considered in silence, her snakes of hair twining among themselves. "For now," she said, "we'll depend on Sarai. Some day we might send Haemum to apprentice with her."

Rod swallowed hard. It was not right, he thought suddenly, that neither the Fold nor the Reverend Father could provide medical care. But then, what did they do for all of L'li? He suppressed disturbing thoughts.

"Rod, there's something else, I'm afraid. Geode says one of our new children is having trouble."

They conferred with Geode on the holostage. "That 'jum wouldn't take her treatments today," the sentient told them.

Rod frowned. "Did the treatment hurt? Was she handled gently?"

"It makes her a bit sick—you can't help that. When the medic insisted, would you believe she threw a stone at him?"

LICENSED TO UNZ.ORG
ELECTRONIC REPRODUCTION PROHIBITED

Rod realized that he had no idea of 'jum's previous background on L'li. He knew Geode would be thinking, What could you expect of an older child?

Mother Artemis asked, "Wherever would she find stones?"

"Her pockets were full of them when she arrived." The sentient waved his two red arms overhead. "At first we let her keep them, as her only keepsake, after all. I've taken them away now, but she manages to squirrel away odd bolts and brackets anyhow."

Rod said, "Let me talk with her."

'jum appeared on the holostage. Her face had filled out, but her eyes were sullen and grim as on the first day he met her.

"I'm sad to hear this, 'jum," Rod told her in L'liite. "I miss you very much. Why do you throw objects at the medic?"

"He's stupid. They're all stupid."

Rod hesitated, not sure how to take this. The medical caterpillar would seem strange to her.

"You told me there would be no more 'creeping,'" she accused.

Now he saw the problem. "There is no creeping, only treatments to make you well and help you grow. There's a big difference."

"I don't feel well. I feel sick."

If only Patella were here to explain; he always helped the children understand. Rod spoke again with Geode alone. "I could change places with you," Rod offered. "The younger babies will be down soon, and they'll need all your arms to hold them. Maybe 'jum will listen better to me."

"Be my guest." Geode replied with exasperation. "When she comes down, I suppose she'll feel at home in the gem mine."

So Rod called ahead to rent a ten-meter cube of living space at Station. Despite himself it occurred to him, at least he would have tasty food at Station. *Love only truth, desire only grace, know only Spirit . . . .*

After dinner—the last Rod would share for a while—Mother Artemis spread her story-robes again. The air was transformed to water, the blue-purple of deep ocean with the sun peering murkily from above. An enormous giant squid rose majestically, its tentacles floating out over the gathered children, its round eyes mysteriously scanning the deep.

On the first world of the first mothers and fathers, in the first ocean there ever was, the creature of ten fingers swam down to the dwelling place of the great Architeuthis. And the ten-fingered one said to the ten tentacles, "Of all things great and fearsome, the greatest and most fearsome of all is the human being. I alone sail the skies, and I sell the stars. My machines plow the earth and build jeweled dwellings taller than mountains. I conquer all knowledge, and my progeny people all the worlds."

Then Architeuthis replied, "Of all things deep and dreadful, the deepest and most dreaded am I. For I plumb the depths and devour the fallen. My tentacles consume whales and comb the abode of giant clams. I ruled the deep for eons before others crept upon land, and my being will outlast time . . ."

LICENSED TO UNZ.ORG
ELECTRONIC REPRODUCTION PROHIBITED

The squid contracted, propelling itself forward in a graceful arc across the night sky. A few tiny raindrops fell, as if genuine spray had emanated from its jet. Rod listened, strangely stirred. The story was sad, for the world of Architeuthis was long gone. Prokaryon's own oceans had barely been tapped; yet who knew what beasts might dwell in the deep?

The next day Rod set off again in the old servo lightcraft. He still longed for word of Gaea, but Sarai had turned off her holostage.

At Station, Geode was all set to come home, with a couple of travel bags slung over his blue arms and tiny T'kela tucked securely in his bright red arm. The infant's treatments had progressed enough for her to visit Prokaryon. It was always a thrilling moment to greet a new colonist, though Rod would miss the celebration for this one.

"Take care," said Geode, his yellow arm sketching the star sign. "You'll find that 'jum helps with the babies, but she refused her treatment for today. If she won't see reason, the clinic will have to tranquilize her."

"We'll see."

"One more thing—I found her a math program, and she spends practically all day on it. She especially likes number theory, power series and Diophantine equations. Irrationals don't hold her interest yet."

"Well, she's only six." Haemum had said that all the children needed more school. What if they, too, had their own talents to be nurtured? The colony had to think about this.

Already two of the babies clamored for attention, so he picked them up one in each arm, then went to the holostage. There stood 'jum, completely surrounded by equations of lighted letters hovering in air. Her hair was a pert bush of black curls, and she wore a red and yellow shift from Mother Artemis's loom. "'jum?" he called to her. "It's me, Brother Rod. I'll be with you from now on. We'll have some wonderful stories."

'jum ignored him and went on pointing to this or that symbol, sometimes dragging one over from somewhere else. Rod watched her curiously, while he bounced the babies. At last he scanned the wall beside the holostage to find the emergency switch. With some difficulty he maneuvered over to the wall to get his hand just beneath the switch, just managing to press it without losing the baby. The lighted symbols all vanished.

Astonished, 'jum looked up. "Brother Rod? What happened?"

"The machine is done for now," he told her. "It will work again, after you've had your treatment."

Her eyes widened. Then they narrowed to slits, giving her the old sullen look again. Her hand went into her pocket where she kept the stones. She stopped, though, seeming to think better of it, and went off to the clinic.

For supper this time, he left early to make sure he and the children got a table to themselves. But as he was gulping forkfuls of shepherd's pie, in between retrieving crawling babies, the new microbiologist came hurrying over to see him.

LICENSED TO UNZ.ORG
ELECTRONIC REPRODUCTION PROHIBITED

Sarai said I could visit her!" exclaimed Khral. "Thank you so much for mentioning me." She held her tray of food expectantly.

"You're welcome." As Rod introduced the children, the dining table extended for one more place.

"And this is Quark," she added, glancing at her shoulder. There perched a nanoplastic eyespeaker. "Quark is our lightcraft." At Rod's look of puzzlement, she added, "The rest of him is docked outside Station."

The round sentient eye swiveled in its clamp. "I've heard about you, Jum," said Quark. "You ought to go to Science Park some day."

Khral settled her tray, and patted the baby next to her. "Quark will take me down to the planet tomorrow. We're so excited!"

"Have you been lifeshaped already?" asked Rod.

"Of course not; I won't live here forever, only to study for a year or two. I wear a skinsuit."

A skinsuit required incredibly delicate servoregulation; the best models were actually sentient. The thin nanoplastic sheath fit itself snugly around one's entire body, with an air filter at the mouth. It had to circulate air and water, while excluding any trace of dust, and stretched itself precisely as the wearer's joints flexed. The young scientists tramped across the Fold in third class yet used such expensive lab gear without a thought. It disappointed Rod, though, that she would not be lifeshaped, like himself and Diorite, the real Prokaryans.

Quark said, "It's surprising how little we know about microzooids, especially since they caused so much trouble in the early days." The first sentients to visit Prokaryon had gotten fouled up by microzoöids, but since then the redesigned nanoplast had few problems. If only human redesign were so easy.

"There's no grant money in it," Khral pointed out. "Singing-trees are sexier. But the veins of singing-trees are full of microzoöids. We'll see what Sarai knows about them."

Rod had a thought. "When you see Sarai, maybe you could check up on Gaea for me."

"Why don't you come with us?"

He thought it over. "I hope your lightcraft's more precise than ours," he said guardedly, thinking of the mountain.

Quark said, "What do you take me for?"

"Of course." Rod was embarrassed. "Well, I don't know, with all these babies."

Khral considered this. "Why not get a babysitter? I'll ask around the lab. . . . Elk Moon's mate would help. He misses his folks on Bronze Sky; he'd be glad to play with babies for an afternoon."

As promised, Quark landed them swiftly and cleanly on the trail just above Sarai's cavern. "This is as close as I'll get," the sentient said. "I don't think I'd fit on the ledge down there. But my eyespeaker will guide you."

Khral's skinsuit covered her like a film of plastic wrap, pressing down her hair and clothes. Her breath sucked hollowly through the mouth filter. She skipped briskly down the

LICENSED TO UNZ.ORG
ELECTRONIC REPRODUCTION PROHIBITED

lower trail, as though Mount Anaeon were just a neighbor next door.

"OK, we're getting close," said Quark's eyespeaker. At their left rose a sheer wall of black rock, with miniature rivulets trickling down; at their right fell the sheer drop to Fork River. Fog billowed in from the roaring waterfall.

Khral seemed to be walking farther than Rod recalled. Had they passed the entrance somehow?

"That's odd," said Quark. "Something's not right here."

"Could we have missed it in the fog?" asked Khral.

Rod did not like the fog at all on this narrow ledge. "Let's turn back." He turned and walked slowly along the rock face, feeling his way. Suddenly the rock gave way, and he fell.

For an instant he thought he had fallen off the mountain. But no—he had fallen *into* the mountain, and not very far, just through the illusory rock face onto the floor of Sarai's cavern.

"Oh!" Khral had tumbled in after him, and she caught his arm.

The plants lit up with their green glow. "You gave my clickflies no warning," announced Sarai.

"Excuse us, please." Khral looked around with interest.

"It's an intelligence test." Sarai leered at the eyespeaker.

Quark blinked indignantly. "Well, I never—"

"We admire your work so much, Sarai," said Khral.

Sarai gave Rod a worried look. "And what are *you* here for? More neglected children?"

"I came to see Gaea. How is she?"

"You don't trust me," Sarai muttered, while Rod repressed the impulse to agree out loud. She led them all down the calcite-studded corridor, clickflies swirling around her head.

There sat Gaea, inside a calyx of enormous green leaves that enclosed her tightly up to her chest. The leaves were attached below to a twisted stem as thick as Rod's arm, that twined off into hidden recesses of the cavern. Not yet seeing him, the two-year-old watched openmouthed as a clickfly danced on a web just outside her reach. With her hands she batted at the bright webbing.

Once she did catch sight of him, she gave a shriek and stretched out both arms. Rod hurried over to hug and soothe her.

"If the stem breaks, she'll die," Sarai warned helpfully.

So Rod spent the next two hours entertaining Gaea, while Khral and Quark visited Sarai's lab. They emerged talking excitedly about things he barely understood.

"The chromosomes are triplex," Khral was saying, "so of course when Prokaryan cells replicate, they divide in three."

"And they divide all the way around the torus," added Sarai. "The chromosome always encircles the central hole; and you end up with three daughter rings."

Quark asked, "You have the enzymes and cell physiology all worked out?"

"And those other aromatic polymers, the ones that do light-activated quantum electrodynamics—Sarai, you've got to report this," exclaimed Khral.

LICENSED TO UNZ.ORG
ELECTRONIC REPRODUCTION PROHIBITED

Sarai looked fierce again. "Those brainless legfish at Station—nobody will understand it."

"You're welcome to visit our next lab meeting," Khral added. "Elk Moon will be summing up his latest work on singing-tree intelligence."

"Singing-trees may harbor lots of microzoöids, but they've got even less intelligence than sentients."

An awkward pause ensued, Khral's tact finally worn thin.

"Does anyone ever study tumblerounds?" asked Rod. "Tumblerounds seem terribly interested in humans."

Khral and Quark looked at him. Sarai muttered, "I know little about tumblerounds. They stay down in the garden rows."

"Interesting," said Khral. "We'll have to take a look at those tumblerounds."

Sarai smiled slyly. "There is one other creature that harbors plenty of microzoöids."

"Really?" said Khral. "What is that?"

"Wouldn't you like to know."

Chapter 6

Over the next few weeks, the two infants completed their first phase of treatment and followed T'kela home to Prokaryon. Now they would only have to come up periodically to progress through the second phase of treatment; within months, they would be eating entirely Prokaryan food. For Rod, of course, this second phase might last for years.

When at last the toddler Qumum had gone home in Geode's eager arms, Rod was left at Station with 'jum, who might take another six months before even making a visit. Mother Artemis was trying to make some arrangement for her care, so that Rod could return; in the meantime he felt empty-handed. The least he could do was pick up odd jobs at Station, but there was little work available for a human caring for a six-year-old. To pass the time he took 'jum "traveling" on the holostage: to the decaying temples of Urulan, where barbarians used to breed gorilla hybrid slaves; to Bronze Sky with its blood-red sunsets and untamed volcanoes, terraformed to settle millions from 'jum's world; and to the floating cities of Elysium, with their gene-perfect children, raised in nurseries where they never knew "parents," only their perfect sentient teachers—like Mother Artemis used to be.

At Khral's invitation he attended Elk Moon's seminar on singing-trees. Elk Moon was a tall Bronze Skyan, of L'lite ancestry; a bush of prematurely graying hair set off his dark features, rather like Rod imagined 'jum's father might have looked. "The singing-trees are the real intelligence controlling this planet," Elk began, his deep voice filling the holostage. "A creature that puts out light signals in thirty-seven distinct colors has got to know what it's doing."

'jum tapped Rod's arm. "A number without children." Her knowledge of Elysian had grown dramatically.

A canopy of the singing-tree forest appeared, at twilight when the colors flashed most, a spectacle to rival any rainbow. Enlargement of a loopleaf revealed specialized tissues that pulsed brilliantly.

LICENSED TO UNZ.ORG
ELECTRONIC REPRODUCTION PROHIBITED

"These pulsing structures we call 'light pods,'" Elk continued. "Each light pod emits millisecond bursts of color—and the repetition rate is always a prime number." Prime series rarely appeared in nature. "Moreover, intriguing patterns emerge: colors red-one and red-five invariably preceded emissions of blue-seven. We know there's a language here, if only we had a Rosetta Stone. Lacking that, we haven't a clue until the natives respond to us—which they tried to do, early on." Elk pointed for emphasis. "Last year, the singing-trees actually started to echo back to us the light signals that *we* sent, almost instantaneously, as if they got the message. Then it just stopped. Why?"

Rod had no idea why. He recalled the story in the news, later put down as a false lead.

"One theory," Elk went on, "holds that singing-trees live on a faster time scale than humans do; perhaps a hundred or a thousand times faster. If they don't hear back from us within seconds, they lose interest; just as our attention would fail, if aliens took years to get back to us. We of course tried to respond, but never caught on in time; and the natives gave up."

Then Station's omnipresent voice cut in. "Singing-trees live for centuries, perhaps millennia. They scarcely move their limbs over our own time scale, let alone the millisecond range. How could they 'talk' any faster than humans?"

"That's where Khral's breakthrough came in." Elk talked faster now. "Khral showed that the light pods actually carry microzoöids to make light—like the bacteria of luminescent fish. Suppose the singing-trees actually talk by *exchanging microzoöids*—luminescent ones, that each encode their data in a matrix of photoproteins. Like luminescent fish, who for example, release their bacteria continually, to colonize other fish. Similarly, if singing-trees transmit their language with luminescent microzoöids, they could transfer enormous quantities of information quickly—just like our nanoservos."

Rod blinked, trying to sort this out. If singing-trees carried little light-flashing microzoöids to talk with other singing-trees . . . how would they try to talk to other creatures—like humans?

"Come on, Elk," said Quark. "If singing-trees really are running this planet, then why can't they let us know? Why have no singing-trees scored more than 10 percent on any intelligence test? Sentients can pick up any frequency, as you well know. Why couldn't we detect anything?"

Rod recalled Sarai's "intelligence test" with a smile. Elk shrugged. "No one's ever tested their microzoöids. Would you test human IQ by examining our excrement?" Laughter filled the holostage.

Khral was elated. "It's fantastic—my idea fits right in," she told Rod at their supper, where they met now most evenings. She always talked at a break-neck pace, and unlike Rod she never seemed to notice what she ate. "Even Station knows microzoöids are the answer; that's why I was hired. We've got to grow those microzoöids in pure culture," Khral went on. "We

LICENSED TO UNZ.ORG
ELECTRONIC REPRODUCTION PROHIBITED

haven't managed it yet—but Sarai has. I must get her formula."

Rod grinned. "Lots of luck."

"Oh, I have things to offer in return." Khral's hair curved pleasantly around her cheeks. "All sorts of goodies from Science Park."

"If singing-trees 'talk' with microzoöids," Rod wondered, "what if they try to 'talk' with us?" The thought took away his appetite, even for shepherd's pie.

"By infecting us, you mean?" Khral smiled in perverse delight. "Now you're thinking like a scientist! Rod, if you've got time on your hands, why not join our next field expedition? We need to collect light pods for analysis, and set up behavioral experiments. But we're short one skinsuit right now—it turned sentient and demanded to ship back to Elysium. Next time, we'll buy from Proteus."

He looked up with surprise. "Proteus Unlimited? How would your sentients feel?"

Khral shrugged. "Quark wasn't happy. But, heck, it was Station's decision. Our personnel costs would double if we had to pay all the skinsuits." She looked at him speculatively. "You don't need a skinsuit. You'd be a great help to us, and earn some cash besides."

"And get infected by microzoöids?"

Khral tapped his arm. "Come on, that was a joke. Microzoöids don't grow in us. You said your colony needs credits—Elysian credits. We'll take care of 'jum again, too."

The expedition included Elk, carrying an eyespeaker for Station, as well as Khral carrying for Quark. The two humans looked freshly lacquered in their paper-thin skinsuits.

Quark brought them all down to a singing-tree forest far to the south of the continent. "Look there, in the wheelgrass," Quark called as he descended. "Tumblerounds—masses of them. It must be a mating convention."

Sure enough, the enigmatic phycozoöids were gathered in a group of fifty or more, their long blue tendrils crossing each other like cobwebs. Quark hovered closer for a better look. The tumblerounds had extended their reproductive tubes into each other in all directions, in a massive orgiastic mating.

"How curious," said Elk. "I wonder how they locate each other."

Khral said, "You're right, Rod, we should look more closely at tumblerounds."

They landed in the forest in late afternoon. The air breathed of ginger and phenolic scents that Rod had missed. Two giant sentient lifters awaited the scientists, hired out for the day from local miners. Each long lifter arm extended a lozenge-shaped passenger seat. Rod and Khral took their collecting bags on board and ascended through the canopy.

"Keep your head down," warned Khral. "You don't want to get hung on the loopleaves."

Rod caught his breath; he could see for many kilometers, all the way to the next band of singing-trees. Even there in the distant canopy appeared sparks of light. "They could send light signals from band to band," Rod exclaimed. "I never thought of that."

LICENSED TO UNZ.ORG
ELECTRONIC REPRODUCTION PROHIBITED

"That's why field work is so important. I could have studied light pods forever at Science Park; but out here, it's the real thing." Khral's voices was softened by the air filter at her mouth. "The light signals could be sent from one band of trees to the next. We're testing that hypothesis now: Elk is going to send light signals from the next band of forest, then see if these trees respond." She reached out and pulled back one of the giant loopleaves of the singing-tree. A light pod could be seen, a luminescent half-moon shape pulsing pale blue. "My job is to collect light pods, to study their microzoöids. Here's how you can help. Each pod you collect, read the wavelength with your photometer," she explained. "Quark will record the results."

Rod hesitated. "If singing-trees really are the 'hidden masters,' how to they feel about having their pods plucked?"

"That's a good question." Khral watched her photometer. "The trees never seem to mind. Their loops grow thousands of light pods. Maybe they don't notice, like having a bit of hair clipped."

The sun was sinking rapidly below the horizon, flooding the forest and plain with an orange glow. Even the surface of Khral's skinsuit twinkled prettily. Silhouettes of helicoids whirled past. Then a breeze arose, and the singing-trees hummed. The canopy was a sea of colored lights now, winking on and off among the loopleaves.

Rod pulled back a loopleaf, several meters long; it had trapped a pool of water in its pocket below, where little hydrazoöids swam. He reached out for the light pod, which pulsed yellow-green. It felt surprisingly cool to the touch.

The photometer whispered, "Five hundred sixty-four nanometers."

Khral nodded. "That's about the right wavelength."

He plucked it gently, offering a silent prayer that the great tree was not really hurt, as Khral had said. Perhaps, he thought, it really did not matter which creature was the "master" here, so long as we treat each one with infinite respect. In the pod, the color slowly faded. Rod went on collecting, the plucked pods gradually piling beside him.

To the east, the nightly rainclouds were moving in. From the west, where the purple sky deepened, there came a low whistling sound. Rod paused, suddenly alert.

The whistling grew to a scream. Out of the corner of his eye, Rod caught a bright flash. Reflexively he dropped to the platform below the rail, pulling Khral down with him, though it would be little help at the top of the lifter.

The shock wave from the distant explosion shattered the stillness. The sentient lifter commenced a distress call, but its arm held steady. Cautiously Rod and Khral raised themselves and looked up over the rail, but the horizon was dark. Rod silently thanked the Spirit for their own safety, and wished the best for those who had fallen.

"It must be a ship," exclaimed Khral. "But whoever would sail in low

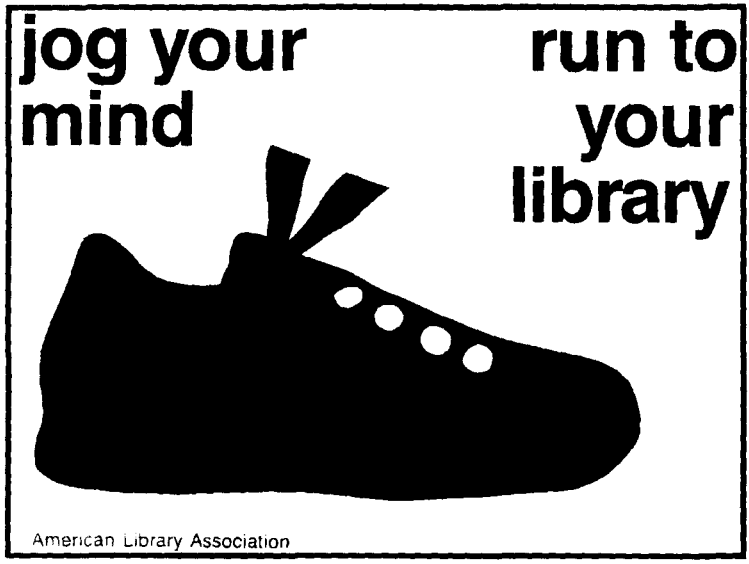
LICENSED TO UNZ.ORG
ELECTRONIC REPRODUCTION PROHIBITED

like that?" Starships always docked in orbit.

Quark reported, "A L'liite ship full of illegals just came in and crash landed."

"Illegal settlers," Khral whispered. "How could they? Don't they know?" Even if they survived the crash, they would only die a slow death—unless rescued soon. ■

TO BE CONTINUED



LICENSED TO UNZ.ORG
ELECTRONIC REPRODUCTION PROHIBITED

Part One of Two

H. G. Stratmann
& G. David Nordley

Biological Hazards and Medical Care in Space

To Boldly Go Where
No Body was Born to Go. . . .

Space is a dangerous place for human beings. People evolved to live at the Earth's surface and are accustomed to "average" conditions there—21% oxygen at a sea level pressure of 14.7 psi, temperatures around 22°C (71°F), gravity of one g, and background radiation of 0.1-0.2 rem/year. Conversely, space means little or no air or gravity, and radiation exposure of 14 rem/year or more. To survive there, we must modify our bodies, take our environment with us, or some combination of both. Part one of this article reviews the near-term dangers space pioneers face—and what can currently be done to deal with them.

* * *

Atmosphere

Not enough oxygen or a sudden reduction in atmospheric pressure can hurt or kill you. The partial pressure of oxygen in the lungs (2.01 psi at sea level) depends primarily on the percentage of oxygen and pressure of inhaled gases. People can live continuously at an altitude of 3660 meters (12,000 feet) with an alveolar (lung) oxygen partial pressure of 1.05 psi. However, this requires extensive physiological adaptation. A nonacclimatized person's mental and physical performance becomes increasingly impaired as alveolar oxygen partial pressure falls below 1.65 psi, with unconsciousness eventually occurring at 0.67 psi or less.

LICENSED TO UNZ.ORG
ELECTRONIC REPRODUCTION PROHIBITED

The first U. S. spacecraft used 100% oxygen at a pressure of 5 psi. This reduced mechanical stress on the capsules and made moving in space suits easier. Breathing a high (70-100%) oxygen atmosphere at that pressure for almost three months was well-tolerated by Skylab astronauts.

However, this practice required "prebreathing" with 100% oxygen to purge nitrogen from blood prior to launch. Breathing pure oxygen continuously at sea level atmospheric pressure (14.7 psi) damages the lungs, causing adult respiratory distress syndrome (coughing, breathlessness, and ultimately respiratory failure) and seizures after as little as six hours—a significant launch window constraint. Also, it created the spectacular fire hazard which led to the Apollo 1 fire that killed astronauts Grissom, Chaffee, and White.

To avoid this risk, achieve compatibility with the Soviet space program, and for other reasons, the Shuttle now uses a "normal" atmosphere—78% nitrogen and 21% oxygen at 14.7 psi. However, space suits must still use about 4.3 psi—higher pressure makes the joints too hard to bend. Extravehicular activity (EVA) requires gradually lowering cabin pressure to 10.2 psi for 24 hours, then prebreathing 100% oxygen for 40 minutes in the space suit, before final depressurization in the air lock to 4.3 psi. Future options range from full pressure hard suits to skin-tight suits that contract to supply the needed pressure mechanically.

The main concerns with sudden loss of pressure are gases trapped in the body's cavities and nitrogen held in solution in its fluids (oxygen is nicely tied up by red blood cells). When pressure decreases too rapidly and/or too much, space travelers can get barotrauma, decompression sickness—and body fluids can literally boil.

Barotrauma occurs when gas trapped temporarily in a body cavity (e.g. sinuses, middle ear, or gut) expands as external pressure goes down. This leads to a pressure differential across the walls of body cavities, causing pain and, potentially, injury. The ear pain experienced by passengers as a jet changes altitude is a mild example of this. The degree of trauma varies among individuals—some are more "open" than others.

More rapid loss of pressure produces decompression sickness—what ocean divers who rise too rapidly to the surface experience. Nitrogen comes out of solution and forms bubbles in the bloodstream, which can impair circulation to various parts of the body and injure them. Effects include "the bends" (pains in joints and muscles), rashes or bubbles under the skin, respiratory distress ("the chokes"), and severe neurological symptoms (weakness, convulsions, or unconsciousness).

Ebullism, the "evaporation" or "boiling" of bodily fluids, occurs when the ambient pressure falls to 47 mm Hg (0.91 psi)—the Armstrong limit, corresponding to an altitude of 19 kilometers. This isn't as serious a problem as it was once thought to be. If you keep your mouth shut, your skin can retain that much pressure.

LICENSED TO UNZ.ORG
ELECTRONIC REPRODUCTION PROHIBITED

Arthur C. Clarke (an experienced diver) has long conjectured that, with proper preparation, one could survive a minute or two in vacuum. Medical opinion has gone back and forth on this possibility. While the latest at this writing is that Clarke may be right, it's also certain that rapid loss of air and pressure without preparation can be fatal, as occurred with Soyuz-11 in 1971.

Sudden, explosive decompression magnifies all the hazards listed above. Eardrums burst, and pressure in the sinuses can cause extreme pain. Air-filled lungs can tear or rupture with a pressure difference as low as 80 mm Hg, especially when the airway is closed, causing bleeding and air embolism. Air bubbles form throughout the body, puckering the skin and blocking blood to the brain and heart. Unconsciousness can occur within seconds, and death within minutes.

The only way to treat this condition is to remove the victim from the low pressure environment immediately and institute a rapid recompression to hyperbaric levels. A hyperbaric chamber to do this will be part of the International Space Station's (ISS) airlock system.

Toxins

A less obvious atmospheric hazard is poison in the air. The volume of air in a space vehicle is much less than what we're used to on Earth. A negligible pollutant down here can be life threatening up there.

Spacecraft contain many toxic chemicals. In the Shuttle, ammonia is used for environmental control and life-support systems. In small concentrations it causes irritation of the eyes, nose, and throat. More severe exposures result in difficulty breathing, vomiting, and damage to the lungs. Freon 21 is used in the heat exchange system. Besides being unhealthy for the ozone layer, if inhaled it can produce lightheadedness, shortness of breath, liver damage, and abnormal heart rhythms.

Hydrazine and monomethyl hydrazine are used to fuel the Shuttle's auxiliary power unit. In liquid form, hydrazines cause severe burns and penetrate the skin to damage the liver and kidneys, or even cause convulsions and death. When inhaled as a vapor, they also irritate and damage the respiratory tract. Cryogenic materials (liquid oxygen and hydrogen) can "burn" the skin.

A liquid that produces a very toxic vapor, nitrogen tetroxide (N_2O_4), is used as an oxidant in the Orbital Maneuvering System because it's hypergolic, i.e. so reactive it doesn't have to be ignited when exposed to hydrazine. This makes the engines more simple and reliable, but puts astronaut at risk of being exposed to it. Nitrogen tetroxide causes burns and blindness in its liquid form—and in zero gravity, drops don't settle. Inhaling its gaseous form causes pneumonitis and pulmonary edema (inflammation and accumulation of fluid within the lungs, respectively), as occurred in the three U.S. crew members of the Apollo-Soyuz mission in 1975. A less toxic alternative oxidizer, red fuming nitric acid (HNO_3), is still as dangerous as its name suggests.

LICENSED TO UNZ.ORG
ELECTRONIC REPRODUCTION PROHIBITED

table 1. medical evaluation of astronaut candidates

Medical History

Physical Examination — including rectal examination, proctosigmoidoscopy, and (in women) pelvic examination and pap smear

Musculoskeletal Examination — including assessment of muscle mass

Cardiopulmonary Tests:

Pulmonary function tests
Exercise treadmill test
Echocardiogram
12-lead electrocardiogram and 24-hour Holter monitor

Eye and Ear Examination — including audiometry, tests of visual acuity and color perception, and tonometry (to check for glaucoma)

Dental Examination

Complete Neurological Examination — including electroencephalogram

Psychiatric Interview and Psychological Tests — including Minnesota Multiphasic Personality Inventory-II and Multidimensional Aptitude Battery

X-rays—of chest, sinuses, and teeth

Abdominal Ultrasound

Mammograms (women only)

Laboratory Tests:

Blood workup (includes chemistries and blood counts)
Urinalysis
Measurement of 24-hour urinary excretion of calcium
Stool checked for blood and parasites
Drug screen
PPD skin test (for tuberculosis)
Screen for sexually transmitted diseases
Pregnancy test (premenopausal women)

(Adapted from Nicogossian et al., *Space Physiology and Medicine*, 3rd Ed.)

LICENSED TO UNZ.ORG
ELECTRONIC REPRODUCTION PROHIBITED

The atmosphere in the closed environment of a spacecraft can also be contaminated by many other substances. Metabolic wastes like carbon dioxide or methane, particulate matter like lint or dust, and off-gassing of nonmetallic materials such as paints and plastics (especially when exposed to heat) must be dealt with.

Current decontamination systems like the lithium hydroxide/charcoal air filters, dehumidifier unit, and catalytic oxidizer used in the Shuttle reduce this problem to manageable levels. This is one area where Russian technology has been particularly effective. Given all the things that can go wrong, their achievement of year-long missions has been a significant advance.

Trauma

Astronauts can get "conventional" injuries, such as burns, abrasions, lacerations, electrical shocks, broken bones, and go into shock. Catastrophic equipment failures can threaten space travelers (Apollo 13) or kill them (Soyuz-1, Soyuz-11, STS-51L).

While falling as such isn't a risk, dangerous zero-g accidents can occur in other ways. One might apply too much force to a task or misjudge a bodily maneuver, and go careening against a bulkhead or other fixed object. Underestimating how much force it takes to stop a slow-moving but massive piece of equipment could lead to the same result.

Deliberate injuries inflicted by some human space travelers on others will eventually occur as enough people go into space and are faced with the stress of a hostile environment. For that reason, at least in the near-term, weapons should probably be banned from spacecraft. To those who might fantasize that this would leave our space travelers defenseless against hostile aliens, the words of Morris Hanson in describing the payload of a lunar mission designed by the British Interplanetary Society in 1939 seem appropriate. "Neither will it be necessary to take along any form of arms, for, in the unlikely event of there being inimical life . . . it is not probable that they would be of a type that would be seriously affected by (such arms)."

Meteoroids and Space Debris

Space isn't empty. Meteoroids—particles of stone and iron moving at an average velocity of about 16 km/sec—are ubiquitous. They represent a potential risk to spacecraft and astronauts, who are especially vulnerable during EVA. It's estimated that 200 kg of meteoroid mass is within 2,000 km of the Earth's surface at any given time. Most of this mass consists of particles 0.1 mm or less in diameter, though they can be as large as 1 cm. More rarely, rocks and boulders traverse this region.

Fortunately, collisions between meteoroids and orbiting spacecraft are infrequent, and two striking in the same place is prohibitively unlikely. So, instead of a hard, brittle material in which the only energy lost by the meteoroid is what it takes to make the circular crack it punches through the shield, you use shielding designed to vaporize, taking the impacting particle with it. Hopefully, you'll end up

LICENSED TO UNZ.ORG
ELECTRONIC REPRODUCTION PROHIBITED

with a small crater on the outside instead of a string of nice crisp entry wounds, all lined up with some unlucky astronaut's head.

Debris from previous rocket launches presents a similar hazard, with about 3 million kg of this man-made "space junk" in orbit within 2000 km of the Earth's surface. It includes objects ranging from meters in size (e.g. destroyed satellites or rocket boosters), to tiny flecks of paint. Over 7,000 objects greater than 20 cm in size are tracked by NORAD. Collision velocity between one of these objects and an orbiting spacecraft would be about 10 to 13 km/sec. The amount of debris 1 cm or less in size is similar to that of comparably sized meteoroids, and requires similar attention to proper shielding.

Acceleration and Deceleration

The trained, physically fit individuals who've flown into space to date tolerated the acceleration and deceleration associated with flight reasonably well. Astronauts in the Mercury program were exposed to accelerations as high as 8 g's briefly during launch, and up to 11 g's with deceleration during reentry. Fighter pilots, suitably supported, can remain functional in 9 g turns.

By comparison, astronauts in the Shuttle experience about 3 g's during launch and 1.2 g's during reentry. This latter force is sustained over some 20 minutes, however, and can still produce lightheadedness or unconsciousness in someone whose cardiovascular system has become deconditioned by days in orbit.

table 2. injuries and illnesses reported during space missions

> Space Adaptation Syndrome *(see text)*
> Nasal and sinus congestion
> Headache
> Skin irritation, infections (boils) and rashes
> Lacerations, bruises, abrasions of the skin
> Upper respiratory infection
> Pneumonitis
> Urinary tract infections and stones
> Prostatitis
> Constipation and diarrhea
> Muscle strains and back pain
> Decompression sickness and barotrauma
> Abrasions of and foreign bodies in eyes

(Adapted from Nicogossian et al., Space Physiology and Medicine, 3rd Ed.)

The limits of this were explored in rocket sled tests in the 1950s—ones that might not be allowed today. One volunteer experienced 83 g's. For three minutes afterwards he experienced a drop in blood pressure, increased pulse, and pain and spasms in the lower back. The same source gives 18 g's as the level at which movements become too difficult to control and 4 g's as a limit for sustained long-term acceleration. Sustained accelerations > 4 g's might require human passengers to be immersed in water or another buoyant fluid.

Temperature

For all one hears about how cold

LICENSED TO UNZ.ORG
ELECTRONIC REPRODUCTION PROHIBITED

space is, reality is that space is the mother of all vacuum bottles—the ideal insulator. With no atmosphere for conduction or convection, heat exchange in space is based solely on radiation, either directly from the Sun or to space itself. For example, on the Moon temperatures range from -178°C in the dark, to 110°C with direct sunlight. Fortunately, effective temperature control systems are available for both space suits and spacecraft.

Thermal management—getting rid of or absorbing heat through radiation—can be accomplished by having the right balance of black and white paint on a space vehicle and doing a "rotisserie" maneuver to average the night and day side exposure. Significant power usage on spacecraft and the 200-300 watts that an active human being generates require adding radiators to prevent overheating. Radiators line the inside of the Shuttle cargo bay doors—it can only manage a limited time with them shut before fuel cells and people get too warm.

Of course, when your spacecraft is painted to radiate in anticipation of a certain level of power usage, and suddenly you don't have that power (e.g. Apollo 13), you will get cold. While uncomfortable, with sufficient food, clothing, and ability to move, a person can tolerate near-freezing temperatures for days. Nonetheless, an environmental control system like the Shuttle's, designed to control temperatures within a range of 18° to 27°C (64° to 81°F), is still recommended.

* * *

Medical Screening and Protection

The greatest challenge to providing medical care in space is the lack of a full infrastructure of specialized personnel, supplies, and equipment—you have to make do with what you can carry with you. Extended missions to the Moon and planets in particular will involve supply decisions and complex trades between mass and medical risk. Participants in these early missions will have to assume greater medical risks than on Earth, and those remaining at home must be prepared to accept whatever consequences arise from that increased risk.

The first step in minimizing these risks is to start with a healthy body. Any existing medical problems need to be identified and dealt with before astronauts go into space. Table 1 summarizes the current medical and psychological tests administered to astronaut candidates. These tests ascertain the astronaut's ability to meet the physical demands of a mission and screen for asymptomatic abnormalities.

For example, exercise tests assess work capacity; presence of coronary artery disease, which could cause chest pain, myocardial infarction (heart attack), and life threatening arrhythmias; and heart rate and blood pressure responses to stress. Echocardiography uses ultrasound to detect abnormalities of the heart's size, valves, and function. Pressure changes and fluid shifts in microgravity increase risk of sinus problems, and X-rays of those areas can help identify individuals with increased susceptibility. Abdominal ultrasound can detect

LICENSED TO UNZ.ORG
ELECTRONIC REPRODUCTION PROHIBITED

gallstones, which can cause cholecystitis (inflammation of the gallbladder). Electroencephalograms measure brain wave activity and detect abnormalities indicating increased risk of seizures

The Shuttle can almost fly itself, but human pilots are still an essential contingency, particularly where vision is concerned. If rendezvous with another vehicle or landing on an emergency runway becomes life critical, you don't want to depend on bad eyes or questionable hearts, as recent difficulties aboard the Mir space station have shown.

Standards for shuttle pilots (Class I) and mission specialists (Class II) are thus more stringent than for payload specialists (Class III) or space flight participants (Class IV). For example, for pilots and mission specialists, near vision must be better than 20/20 in each eye (uncorrected) and blood pressure ≤ 140/90 mm Hg, while for payload specialists and flight participants, there are no limits on near vision and blood pressure ≤ 150/90 mm Hg is allowed.

Medical examinations are repeated 10 days, 2 days, and immediately before launch. To minimize preflight exposure to infectious diseases, crew members live in restricted quarters for a week prior to launch.

The next step is to provide backups. Redundancy is as important in human systems as in electronic and mechanical ones—losing a critical crew member would place the others in danger. Two members of every Shuttle crew are assigned as crew medical officers (CMOs). Those who aren't physicians receive paramedic-level training in diagnosing and treating medical and dental problems. During flight, advice is available from a ground-based Crew Surgeon and Deputy Crew Surgeon.

All Shuttle astronauts receive 16 hours of lectures on the physiological effects of space flight, 4 hours of training in psychological issues like stress management and conflict resolution, participate in water and land survival courses, and experience brief periods of simulated microgravity in an aircraft flying a parabolic course. Basic techniques for cardiopulmonary resuscitation and first aid are also taught.

As space travel progresses from a dangerous experimental activity to what amounts to a publicly (or, eventually, privately?) supported transportation system, preflight screening will begin to raise significant ethical issues. Will people with certain ear, heart, neurological, or cancer-prone conditions be forever banned from traveling to space colonies or other planets? How much effort should be spent in allowing more people to go as far as we have gone versus sending a few people much farther?

There's clearly a three-cornered trade between a) selecting people who are less prone to space illnesses; b) putting more engineering effort into making Earth-like habitats in space; or c) making temporary or permanent modifications to people to make them more space-tolerant.

In any case, to provide fair, proportionally increased access, the medical infrastructure of space will need to in-

LICENSED TO UNZ.ORG
ELECTRONIC REPRODUCTION PROHIBITED

crease in proportion to the space population. This will likely occur gradually, with less and less screening needed as time goes on. The challenge will be to keep screening appropriate to where space travelers go and what they do, to not force access issues prematurely, but at the same time, not let screening become an arbitrary means of reducing the pool of space travelers.

Medical Practice in Space

Even the very healthy, physically fit men and women who've traveled into space to date have become ill and required treatment. Table 2 lists the major illnesses and injuries reported so far during space missions. The types of medications commonly stocked on board spacecraft to treat them are shown in Table 3. In addition, basic medical supplies and equipment are also carried. These include syringes; needles for drawing blood, starting intravenous lines, and administering medications; suture equipment; scalpels; surgical masks and gloves; and a stethoscope and blood pressure cuff. Equipment for advanced cardiopulmonary resuscitation and support (e.g. a defibrillator or ventilator) is not included on Shuttle flights, but will be on the ISS.

The current level of medical care available on space missions includes the ability to treat minor illnesses, provide first aid, and perform basic cardiopulmonary life support. More serious illnesses and injuries require stabilization of patients and transport back to Earth for definitive care. The latter can be done relatively easily on Shuttle missions. The ISS will have one or two vehicles docked continuously for this purpose. For the first missions to the Moon, Mars, or asteroids, however, this will be a considerably less practical option.

Complicating all this is the lack of gravity. Fluids won't drain away, limbs won't stay put, sponges and other equipment that aren't tied down will float to where they make the most nuisance. CPR, attempted the normal way, will push the aid-giver away instead of compressing the chest and heart. Treating a seriously injured or unconscious person in microgravity requires that both victim and rescuers be firmly secured to some surface with restraints.

Low gravity produces a fall in circulating blood volume and a temporary loss of red blood cell mass similar to mild anemia and dehydration, thus decreasing a person's reserve in case of severe bleeding. Fluid shifts to the upper body make it more likely that head trauma could cause swelling and damage to the brain. Slow or inadequate healing of bone fractures could also occur, due to lack of normal stress which promotes bone growth.

Techniques used to diagnose certain medical problems won't work in microgravity. For example, in someone suspected of having blood or other fluid in their chest due to injury, pneumonia, etc., turning them on their side and taking a chest X-ray won't show the usual gravity-induced "layering out" of fluid.

Likewise, an X-ray taken in a sitting position won't show air rising to the upper part of the abdomen after rup-

LICENSED TO UNZ.ORG
ELECTRONIC REPRODUCTION PROHIBITED

ture of the stomach or intestines. Air fluid levels often seen in obstruction of the small intestines would also not be seen on X-rays of the abdomen, making it more difficult to decide whether surgery might be needed to prevent life-threatening damage to them.

Of course, this assumes an X-ray machine is available. In fact, few if any of the imaging devices now available in any reasonably-sized hospital—X-ray, ultrasound, gamma scintillation cameras, computed tomography, and magnetic resonance imaging machines—will be immediately available in space to assess medical emergencies. With the exception of the simplest X-ray machines, current Earth-based imaging systems are heavy and bulky. It would be grossly impractical to put them on the ISS, much less cart them on initial missions to the Moon or Mars!

But—when we have enough people in space to justify the expense—engineers need to be challenged to reduce the mass of medical equipment. New microgravity designs of much of this equipment could weigh considerably less because much of their mass is structural and could be significantly reduced in microgravity. If the chemical laboratories carried by the Viking landers are any guide, given the right incentives they should be able to do some remarkable things.

Imagine a CAT scanner the size of a hula hoop, for instance. If such equipment were available, then obtaining the advice of medical specialists on Earth via transmission of imaging data and telemedicine becomes practical. For example, a new compact ultrasound system will be on the ISS. Reduced size, increased portability, and eventually lower cost of medical equipment on Earth could be an important spin-off of efforts to provide more capability for space doctors.

Space Sickness

Within minutes of achieving orbit nearly two-thirds of astronauts experience Space Adaptation Syndrome (SAS). Symptoms (headache, nausea, vomiting, dizziness, and malaise) worsen with head and body movements, peak at day one to two, usually resolve by day four in orbit (although they may persist several weeks), and often recur on return to Earth. Men are affected more frequently than women (65% versus 38%, respectively). The problem tends to be less severe in astronauts who travel into space a second time.

Susceptibility to SAS doesn't correspond to predisposition to the usual motion sickness caused by ships or rotating chairs. Its cause isn't known, but may be due to sensory conflict between the astronaut's visual perception of their environment, and what the neurovestibular system (the parts of the inner ear and brain which identify the body's orientation and maintain balance) is sensing. The latter system is "wired" based on lifelong experience in 1 g to expect certain relationships between what a person sees and their motion and posture. On initial exposure to microgravity, the brain has to learn an entirely new set of relationships. While it does so, it reflexively activates parts of the au-

LICENSED TO UNZ.ORG
ELECTRONIC REPRODUCTION PROHIBITED

tonomic nervous system and causes the aforementioned symptoms.

Standard motion sickness remedies like scopolamine and dimenhydrinate (Dramamine) are reasonably effective for dealing with SAS until adaptation occurs.

Infectious Diseases

Infections present a major health risk in space. Vigorous screening and isolation of crew members prior to going into space reduce this risk. However, in the closed environment of a spacecraft or habitat, they will still be exposed to bacteria, fungi, and viruses from many different sources.

Concentrations of airborne bacteria and fungi are reduced but not eliminated by particulate filtration systems. The upper limit for microorganisms proposed for the ISS is 1000 colony-forming units/m^3 of air, which is slightly higher than the standard used for U.S. office buildings.

Drinking water is another possible source of contamination. On the Shuttle, it comes from stored supplies and fuel cells. Water produced by the latter is first disinfected by passing it through an iodinated resin. This system reduces levels of bacterial contamination to terrestrial standards. Recycling of contaminated water derived from air, urine, and wash water is necessary on the ISS and long missions away from Earth. Various methods, including filtration, membrane evaporation, and distillation are being investigated to meet the standard of ≤ 1 colony-forming unit/100 ml of water.

Food is processed preflight by freeze-drying, thermostabilization, or other methods so it contains no more than 10^4 aerobic bacteria per gram. It's also tested for presence of bacteria that commonly cause food poisoning, such as *Salmonella*, *Shigella*, *S. aureus*, and *C. botulinum*. Experimental animals can harbor microbes transmittable to crew members, and must be tested for such pathogens before launch. Conversely, plants aren't a significant source of human pathogens. Payload items, especially microbial experiments, may also cause contamination.

The most important source of microorganisms in space, however, is the astronauts themselves. Even a "healthy" individual has about 10^{12} bacteria on the skin, 10^{10} in their mouth, and 10^{14} in the gastrointestinal tract. Fortunately, the vast majority of these bacteria are commensal—they don't cause disease, or do so only after the host is injured. Some are even symbiotic, producing substances like Vitamin K (needed for blood clotting) beneficial to the host. These "good" bacteria also protect against infection by more virulent microorganisms by competing with them for the same nutrients, producing chemicals that kill them, and providing chronic, low-level stimulation of the body's immune system so it's constantlyly "primed" to fight infections.

Microorganisms are continuously shed from skin, mucous membranes, and the gastrointestinal and respiratory tracts. Sneezing, coughing, and even talking release microbe-laden aerosols into the confined environment of a spacecraft, ready to be inhaled by other crew members. On

LICENSED TO UNZ.ORG
ELECTRONIC REPRODUCTION PROHIBITED

Earth, these tiny droplets settle to the floor within seconds or minutes. In microgravity, however, they remain suspended until colliding with some surface like a crew member's skin or mucous membranes, where they can cause an infection.

In microgravity a cubical cabin three meters on a side would require a throughput of 27 cubic meters/minute to approximate the settling effect of Earth's gravity. On Mars and Luna, if settling time is proportional to gravity, drops in a one bar atmosphere will take 2.6 and 6.25 times as long to settle, respectively.

Urine and feces are other major sources of contamination. Methods for collecting and disposing of wastes in microgravity range from simple cuff/bag systems for urine and stick-on colostomy-type bags for feces, to the somewhat notorious Shuttle toilet, in which air flow directs wastes immediately away from the body and into processing equipment. This latter system collects feces into a single container for vacuum-drying and eventual return to Earth.

Maintaining personal hygiene to reduce risk of infection and for psychosocial reasons is difficult in microgravity. Washing hands, face, hair, and especially showering require large quantities of water which is either in limited supply, or requires recycling with attendant problem of removing soap, microorganisms and other contaminants. Containment and collection of released water is also a major problem. A hand washer is used on the Shuttle, but is too inefficient in its water reclaiming abilities to be useful for long missions. A bag-like shower system was used on Skylab, but was deemed too difficult to set up and operate.

Experiments using high-velocity moist air (perhaps laced with a high percentage of oxygen) instead of water might be indicated. A disk emitting this air from its rim and suctioning it up in the center could be run over the body.

Finally, exposure to the space environment has been reported to increase resistance of pathogenic bacteria to antibiotics. Whether this is due to the effects of mutation from radiation, microgravity itself, or other factors isn't known. However, coupled with the body's impaired immune system function in microgravity (see Part 2 of this article) and limited availability of antibiotics, it could be a major hazard in very long microgravity missions.

Spacecraft designers should be concerned with eliminating places where bacteria can hide from air flow. Direct sunlight, with its high ultraviolet content, could be flooded into compartments from time to time. Finally, on very long missions, periodic exposure of cabins to the vacuum of space may be contemplated.

In the far future, one can contemplate cybernetic nanotechnology systems able to read the DNA of a bacterium or a virus like a book and design foolproof killers for them in microseconds. In the meantime, *Homo Astronauticus* will just have to keep clean.

Space Pharmacology

The effectiveness of medications can also be altered in space. Reduced

LICENSED TO UNZ.ORG
ELECTRONIC REPRODUCTION PROHIBITED

table 3. types of medications commonly carried on space missions

Class of Medication	*Indication*	*Examples*
Analgesics and non-steroidal anti-inflammatory agents	Pain relief, reduction of inflammation	Acetaminophen (Tylenol), Acetylsalicylic acid (Aspirin), Meperidine (Demerol, IM or IV), Ibuprofen (Motrin)
Antiemetics	Nausea, vomiting	Scopolamine and d-amphetamine, Scopolamine (patch), Promethazine (Phenergan), Prochlorperazine (Compazine)
Antihistamines and H1 blockers	Nasal congestion	Oxymetazoline (Afrin) nasal spray, Pseudoephedrine (Sudafed), Terfenadine (Seldane)
Central nervous system stimulants	Increase alertness	D-amphetamine sulfate (Dexedrine), Caffeine (NoDoz),
Cardiovascular agents	Angina pectoris and arrhythmias	Trinitroglycerin (sublingual), Lidocaine (Xylocaine, IV), Atropine (IV), Procainamide (Pronestyl, IV)
Antibiotics	Treatment of bacterial infections	Ampicillin, Erythromycin, Penicillin, Tetracycline
Sedative-hypnotics	Insomnia	Flurazepam (Dalmane)
Gastrointestinal agents	Diarrhea, constipation, heartburn	Diphenoxylate/atropine (Lomotil), Bisacodyl (Dulcolax), Mylanta
Dermatological agents	Skin rashes and infections	Kenalog 0.1% cream, Mycolog cream, Neosporin ointment
Ophthalmic and otic agents	Eye and ear irritation	Methylcellulose eye drops, Cortisporin otic solution

IM = intramuscular; IV = intravenous

LICENSED TO UNZ.ORG
ELECTRONIC REPRODUCTION PROHIBITED

gravity causes changes in blood flow and motility of the gastrointestinal tract, thus affecting absorption of drugs taken orally. Drugs are removed from the body by metabolizing them to less (or sometimes more) active substances in the liver or other body organs, excreting them through the kidneys, fecal loss, or a combination of these methods. Functions of these organs are changed by reduced gravity, which could in turn affect how the drugs they act on work. Fluid shifts and changes in blood flow within the body caused by reduced *g* could also alter the distribution of administered drugs and their effects on target organs.

At present, few data are available regarding the net effects of these changes regarding specific drugs. Oral medications like scopolamine used to treat space motion sickness have shown less than expected effectiveness. In one of the few studies on this subject, absorption time of acetaminophen (Tylenol) was prolonged, suggesting reduced potency.

Chronopharmacology is the field which studies the effects of the time medications are taken on their effectiveness. Physiological changes linked primarily to an individual's circadian rhythms cause changes over time in the body's need for drugs and its ability to absorb them.

For example, the risk of heart attack is highest during early morning hours. Drugs designed to reduce that risk therefore should be given in such a way that they retain effectiveness over that period. In the space environment, however, disruption of "normal" circadian rhythms and microgravity-induced physiological changes reduce predictability regarding when a drug should be given for maximum effectiveness.

Understanding these issues is especially critical for long space missions with limited medical supplies, when it's especially important to get the "most bang for the buck" when medications are taken. This field of research is still in its infancy.

Surgery in Space

It should be anticipated that first aid and surgical procedures in space will, at least in the beginning, take longer than on Earth. Performance of therapeutic procedures and surgery will be different and generally more challenging in reduced gravity.

For example, on Earth, initial treatment of a patient who is hypotensive (low blood pressure) due to dehydration or blood loss includes placing them on their back and raising the legs higher than the head. Gravity makes blood in the legs go to the upper body and heart, where it can be pumped more effectively to the brain. Conversely, someone who has swelling of the brain or difficulty breathing from congestive heart failure may benefit from being placed head upright. This makes blood pool in the legs, decreasing harmful leakage of fluid into areas like the lungs. Neither maneuver works in microgravity. While other means are available to deal with medical emergencies like this, they take longer to implement—time that could mean the difference between life and death.

LICENSED TO UNZ.ORG
ELECTRONIC REPRODUCTION PROHIBITED

Data on performance of operations in microgravity are limited to animal studies done either in space or during parabolic flights on Earth. During an operation, venous blood forms hemispheres of increasing size instead of oozing. Blood also adheres to surgical instruments and gloves, making them increasingly difficult to use. A spurting artery produces blood droplets suspended in the air, which contaminate the immediate area and can be inhaled by anyone nearby. During an operation on the abdomen, viscera like the intestines float out of the body, making any procedure more complicated and increasing the risk of infection.

Maintaining sterile technique during an operation in space is also challenging. Normally, a packaged surgical gown is "shaken out" by the person who'll wear it, taking special care it doesn't touch a non-sterile surface. In microgravity, a second person would have to secure the edge of the gown to prevent it from floating free and being contaminated. The operating area itself can be contaminated by airborne particles which, in a terrestrial operating room, would have long since settled to the floor.

Even putting on surgical gloves is difficult—trying to remove and put on the first one can cause the still-packaged second glove to float away. Sterile drapes used to cover the patient must be secured on at least two sides, and surgical instruments such as scalpels and hemostats must be fastened down when not being used.

Gravity would not hold temporary wound dressings in place, though surface tension and blood clotting might suffice. A less strong version of the new surgical glues might be useful for this.

The standard gravity-assisted technique of raising an intravenous fluid bag higher than the patient won't work. Even the mundane tasks of collecting and measuring body fluids such as urine and blood are difficult, since they won't flow "downward" or settle to the bottom of a container.

Standard techniques for setting and applying traction to bone fractures depend on "normal" gravity, and new methods will have to be devised to perform these functions in space. In general, calibrated spring or elastic tension devices will have to substitute for weights.

Washing and disinfecting surgical equipment will require special equipment.

For most of these problems, there are obvious engineering answers. Microgravity operating theaters will need high volume air recirculating systems which send clean air toward the patient and draw contaminated air away. Surgical tools may need to contain enough ferromagnetic material to cling to magnetized trays. Sample centrifuges would need to be standard theater equipment. IV bags can be enclosed in pressure vessels, as is done with fuel bladders in spacecraft attitude control rockets—the dose rate would be adjusted by changing the pressure on the outside of the bladder. An expandable plastic chamber placed immediately over the operating area may also be used, with surgeons operating through built-in sleeves fitted with surgical gloves.

LICENSED TO UNZ.ORG
ELECTRONIC REPRODUCTION PROHIBITED

But microgravity operating theaters may have advantages too. Surgical tools will not fall into the patient or onto the floor. The volume above the patient will be available to place additional assistants—nurses may literally "float" around the operation. Both sides of the patient can be accessible.

And, finally, a near-infinite amount of vacuum is available to power all the suction devices this kind of surgical theater may need.

Conclusion

If much of this seems familiar to readers of the classic literature of space exploration, it's a tribute to the authors of that literature. One is amazed at how well Tsiolkovsky, Oberth, Von Braun, and Clarke (to name a few) anticipated the problems and their solutions—and how they had the courage to persist in the face of plausible-sounding but ill-considered objections raised by reputable people which later proved to be, indeed, so much nonsense.

But familiarity can breed contempt, and, from time to time, known problems surface. People have died in a pure oxygen fire, while separating from spacecraft without being in pressure suits, and because they were unable to bail out of falling spacecraft cabins. There have been close calls with an explosion involving a cryogenic oxygen tank, a potential knife fight, a collision with another spacecraft, and a debris impact that dug a chip out of a spacecraft window.

Despite these risks, current technology allows humans to reach and stay in space with reasonable safety for year-long missions. Part 2 of this article will focus on two factors which set the greatest biological limits on how long individuals can live in space—microgravity and radiation. How these hazards are dealt with will ultimately determine whether space-faring humans remain only visiting "tourists," or become homesteaders in the final frontier. ■

TO BE CONCLUDED IN THE NEXT ISSUE.

The first documentary photographs showed "the world as it really is" by portraying the corpses on the battlefields of the American Civil War.

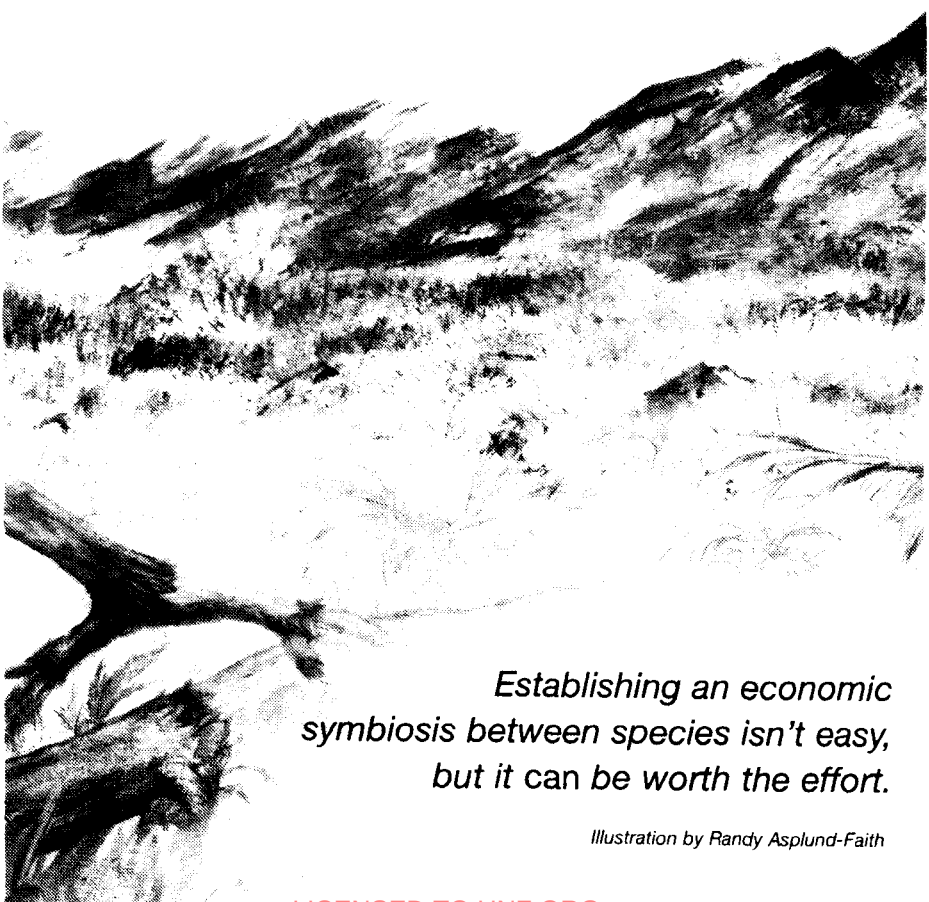
—C. W. Ceram

LICENSED TO UNZ.ORG
ELECTRONIC REPRODUCTION PROHIBITED

LICENSED TO UNZ.ORG
ELECTRONIC REPRODUCTION PROHIBITED

Stephen L. Burns

The Coverture Incident



Establishing an economic symbiosis between species isn't easy, but it can be worth the effort.

Illustration by Randy Asplund-Faith

LICENSED TO UNZ.ORG
ELECTRONIC REPRODUCTION PROHIBITED

It was another warm and humid Marguy afternoon. Joe Swamp, the planet's Bureau of Alien Affairs Station Chief, was whiling away the time in climate controlled comfort.

He was slouched back in his chair, sneakers parked on his desk and a cyberloupe worn like a headband, deep in a game of Bug Hunt. In the air before him a considerably more muscular and athletic version of himself glided soundlessly through an alien forest, the beaded leather strap of a quiver crossing his brown chest and a nanomic compound bow in his hands, an arrow already nocked. A faint rustling sound came from somewhere to his avatar's right. He whirled smoothly toward it, his long braided black ponytail whipping through the air. That detail was one of the few where Joe and his simulacrum were exactly identical; some were idealized, others were quite the opposite. Joe would *never* be caught dead wearing a breechclout in real life.

His eyes narrowed in calculation. His avatar's did the same. That sound had to be either a swordbeak or a hunny hiding there in the underbrush. He could call out. If it was a hunny it would answer, and he wouldn't take the risk of shooting it. But the sound of his voice could make a swordbeak spring like a javelin. The real and virtual Joes remained tense and silent, waiting.

The leafy cover shivered. Something was about to—

"Joe! Bull is here to see you!"

At the very instant he was distracted by Mabel's voice a blur of motion erupted from the greenery. Joe flinched, and his avatar swung his bow up, aimed, and loosed his bolt in one fluid, deadly motion.

"Aw hell," Joe grumbled, staring at the hunny sprawled on the dirt, his arrow spiking it to the ground. The creature's doelike brown eyes regarded Joe's avatar with hurt surprise. "Why you shoot me, you?" it gasped breathlessly. "Why man why?"

There went a thousand points for hitting a harmless sentient. He shook his head and sighed. Some Indian he was. It was a damn good thing he didn't have to depend on hunting for his survival the way his ancestors had; he would've ended up either starving or eating a lot of neighborburger.

"Joe?" Mabel's voice blared again, its slightly freaked edge showing how nervous having Bull hanging around made her. Six months on Marguy and the Guys still unnerved her.

Joe snapped his fingers to make the game disappear. "Send him in," he said, hauling his feet off the desk and sitting up straight. *Bureaucrat on duty.*

Bull ducked through the doorway a moment later. Joe watched the big alien approach his desk with his usual exaggerated caution, curved black toe-talons clicking against the permaplast tiles. Except for the pair of thick-framed spectacles hanging from a heavy chain around his neck, and bouncing against his massive chest with every ponderous footfall, he looked like some old time movie monster stalking lunch.

"Good to see you, Bull. What's up?" Joe put a smile on his face with prac-

LICENSED TO UNZ.ORG
ELECTRONIC REPRODUCTION PROHIBITED

ticed ease. Losing all those points in the game still bugged him, even though he had just been wasting time with it. As for Bull's appearance, which had no doubt sent Mabel, straight for the bottle of sherry she kept hidden in one drawer of her desk, that didn't bother him at all.

The *guymarguyimaranguyital*—Guy for short—ducked its broad armored head, the fanged maw on the top front of its bony skull opening in his species' somewhat unnerving approximation of a human smile. That mouth was big and toothy enough to eat something the size of a whole pig the way Joe would munch a hot dog, and its only function was eating.

When Bull spoke his voice issued from a narrow slit below the two big glassy black eyes protected by a horny crest at the center of his face. Below that, down where a human's mouth and chin would have been, was the plated bulge of its braincase. Bull's voice was soft and cultured, totally at odds with his fearsome appearance. Joe always thought of them as looking like tail-less velociraptors with a gorilla's upper body shape and their heads on upside down, and sounding like a cross between a butler and a reference librarian.

"Good day to you, Mister Joe. As to what's up, lamentably I must inform this is not a mere social call." Although Bull was the Guy who conducted most of his kind's diplomatic dealings with humans, they all talked that way. Their native language had been developed not so much as a means of communication—they were all moderately telepathic—but as an artform.

Humans had landed on their planet's single small continent armed with heavy-duty translator progs and the wrongheaded expectation that a race which didn't even use fire would be unsophisticated primitives with crude language skills and a simplistic approach to the creation of a treaty. Within two days of first contact the Guys were answering in perfect Anglish limited only by the number of words they had heard so far, and talking about *codicils* and *mutually beneficial entente*. The palm-sized cybotic dictionary Bull had been given led to their quite often using Anglish words the humans on Marguy had to look up.

"Please sit down. Take a load off."

"Thank you." Bull lowered his 250+ kilo body onto the sturdy hassock there to provide seating for his kind. "Regretfully I am again compelled to protest trespass by your machines on the Coverture."

Joe wasn't surprised, but that didn't lessen his irritation at having to once again deal with this ongoing problem. In spite of himself he took some of it out on Bull. "They're not *my* machines, Bull. You know that."

"I do. Yet is it not your task, indeed your vocation, to see that the terms of our treaty with your kind are honored?"

"It is." Joe knew he'd made a mistake taking that tack. Now Bull would go through the entire situation piece by piece.

"Was it not agreed by all signatory parties that no human machines were to be permitted inside the boundaries of the Coverture?"

"That was the agreement."

Bull spread his sinewy, three-fin-

LICENSED TO UNZ.ORG
ELECTRONIC REPRODUCTION PROHIBITED

gered, taloned hands in an entirely human gesture, the obsidian discs of his eyes unblinking and direct. "Then why do these infractions continue, Mister Joe?"

Joe knew it was because Frank Testa, BioCosmoTech's site operations director, couldn't resist trying to gather biologic materials from the huge protected area the Guys had named the Coverture. Because a KEEP OUT sign drew humans like road kill drew crows and flies.

"As I've told you before, the automated gathering machines have a hard time recognizing the border of the Coverture and make occasional accidental incursions."

Bull toyed with the glasses hanging around his thick neck as if considering putting them on to better examine this lame excuse. "This happens too frequently to be an accident, Mister Joe. We are compelled to hypothesize that it is being perpetrated on purpose."

"I'm sure it isn't," Joe replied, lying through his teeth. Testa kept saying it was one of those shithappens things, but he didn't believe it any more than Bull did.

"I am sure I need not remind you that there is no honor in a willful breach of a sacred covenant. Nor can there be any real gain from such malfeasance, only loss."

"I know, we've been over all this before."

"Yet these incursions continue. No infraction can be considered inconsequential. These are not minor annoyances, but abrogations of the contract we have entered."

Joe knew how Bull felt, and knew that there was no way to make him understand that these *were* minor annoyances compared to the raw deal some races got from dealing with BCT and their smaller ilk; that without a Bureau of Alien Affairs agent like him there to referee, Frank would be going wherever and taking whatever he wanted whether they liked it or not. Sure they deserved stricter compliance, but they could be getting one hell of a lot worse.

"I'll talk to Frank and register your complaint. I'll also see that you get some sort of compensation for these, ah, most recent lapses. Fair enough?"

"I am sure you will ensure fair redress. At the risk of sounding tiresomely redundant, I must point out that such palliative measures should not be required in the first place."

Bull stood up, his head nearly brushing the ceiling. "We have trusted you and your kind by signing a treaty which allows you to dwell on and take things from our home. We have most certainly gained from this arrangement." He lifted his glasses to illustrate that point. "It would be in the best interests of both our races for this entente to continue. Still, for such a relationship to endure our trust must not be betrayed."

"We're doing just fine here," Joe insisted. "We've just got a few problems to be worked out, that's all."

"Those are very nearly the precise words you used last time I came to lodge protest."

Guys never forgot *anything*. "Because it's true."

The gigantic native stood there gaz-

LICENSED TO UNZ.ORG
ELECTRONIC REPRODUCTION PROHIBITED

ing at Joe, his expression unreadable. The faces of the Guys were too alien and immobile to offer clues as to their thoughts or mood, but sometimes their posture gave hints. Bull's body settled into what Joe thought of as their pensive crouch. He could be thinking, or even communing with who knew how many other Guys. After a few moment he stood straighter and scratched the armored bulge of the braincase down below his gleaming black eyes.

Joe relaxed at seeing this. It meant Bull was reminding himself that he didn't know all there was to be known about humans, and so may have been mistaken in his assumptions. Caution and deliberation were two hallmarks of Guy personality—thank the Great Spirit for that! A hotheaded Guy would be hell on wheels.

"If you tell me this it must be true," Bull intoned.

Joe made himself smile. "It's my job to protect the interests of your people, and I'm doing the best I can." In other words I may be shading the truth a bit, but I'm doing it for your own good.

Bull nodded, a human habit the Guys had adopted early on. "Then I shall depart and cease being an impediment to the performance of your duties. Good day to you." He headed toward the door, taking the cautious, almost mincing steps the Guys took around fragile human artifacts, moving with the focused care of someone trying to drive a tank down the aisle of a china shop.

This was manners, not a lack of coordination between the two separate entities of which Bull and his kind were made. The highly intelligent, eminently reasonable person who Joe knew as Bull was a cat-sized symbiote residing in that armored braincase. The body carrying him was that of a creature which when feral and unoccupied they called an *imarguymarguyakh* or imar for short; a deadly predator which made the terrestrial grizzly bear look like a cuddly puppy in comparison. Bull's control of his imar body was absolute and perfect. His kind had lived that way for thousands of years.

Joe let out a sigh of relief when Bull closed the door after himself. It wasn't that the Guys were dangerous; for all their fearsome aspect they had never showed a single sign of violent or warlike tendencies. It was more a matter of them being like some of the tribal elders he'd grown up around back on the Rez. They adhered to a strict code of rules and expectations real people dealing with real situations in the real world could almost never meet. There were times Joe wished they *were* meaner. It would make his job a lot easier.

He got up and headed for the refreshment center at one side of his office, hoping he had time for a soothing cup of something before Frank Testa turned up. That was usually the way it worked. Not long after the rock left the hard place turned up.

He opened the wooden box he used to store his *tlat*, a dried plant from Tefford II used to make a stimulating and yet centering tea. One of the thousands of alien biologics which were BCT's stock in trade, it cost twenty

LICENSED TO UNZ.ORG
ELECTRONIC REPRODUCTION PROHIBITED

times as much as the finest estate-grown teas and coffees from Earth. Frank had introduced him to the stuff, and in doing so given him a taste for a pleasure he really couldn't afford.

The box was nearly empty. He wistfully eyed the small heap of purple leaves left in one corner, knowing he should just close the box and fix something else. He didn't really need to drink *tlat*, and as long as he wasn't out he wouldn't need to think about how he really shouldn't ask Frank for more. The site director was always doing things to make him feel obligated. Helping him would only make his situation more difficult.

Just as he was closing the box Testa came breezing into his office without warning. Time and again he'd asked Mabel to at least give him a "Frank's here," but somehow that never happened. Probably because she worked for Frank and not him.

"Hey there, Joe!" Testa boomed cheerfully. "You brewing up some *tlat?* Stunning." He reached in his jacket pocket and produced a red and silver packet with the royal blue BCT logo on it. "Here, you must be getting bloody low, the way I keep drinking it up on you." He tossed the pack toward Joe, who caught it by reflex.

"That's OK, Frank," he began. "I really don't need any."

"What's *need* got to do with it? Hell, it's the least the company can do considering the great job you're doing, Chief."

Joe stood there holding the pack, his face giving away no more than Bull's would. Sure he was chief—and only—BAA agent here on Marguy. But he always had the nagging feeling that Frank used the title in subtle mockery of his Native American heritage. The problem was Frank had one of those bluff, always grinning faces and superior attitude that made everything he said sound like a joke at someone's expense.

Still, part of his job was to get along with the man. That was his place, to be caught between the simple black & white world of the Guys and the cunning, calculating corporate grey zone Frank represented.

"Two *tlats* coming up," he said, turning to brew them.

Shortly afterward they were seated in the easy chairs over by the curved perspyl wall which made up one corner of Joe's office. An office Frank had given him to use, one a hundred times roomier and better appointed than the cramped, stuffy prefab hut the BAA had provided. BCT's onsite accommodations were in the upper level of a huge special purpose lander, and first class all the way, BAA's something closer to steerage. The small sleeping compartment off his office was bigger than the entire hut.

Frank had taken off his hat, flopped into a chair and parked his boots on the table, making himself at home. He looked like the Great White Hunter taking a break between safaris—what with his sun-browned skin, sun-bleached hair, fussy white mustache and permanent hunter's squint. All he lacked was an elephant rifle and native bearers. This was an image he cultivated; he also affected a lot of early 20th century British slang to go with

LICENSED TO UNZ.ORG
ELECTRONIC REPRODUCTION PROHIBITED

his appearance. Joe knew Testa had actually grown up in Cleveland.

Testa took a slug of *tlat*, sighed with pleasure, then regarded Joe over the rim of his cup. "I hear my old chum Bull was just here to see you."

"How did you hear that?" Joe asked, not really expecting a straight answer. Testa always seemed to know everything, but treated him like a mushroom. He could see the shit-shovel coming, even in the dark.

The site director's ever-present grin widened. "Oh, I hear things. You know how it is."

"I'm learning."

"That's because you're sharp, Joe. Damned sharp."

Joe lobbed the compliment back. "So are you, Frank. That's why I have to wonder why your gatherers keep trespassing on the Coverture."

Testa chuckled. "I may be a grade A site ramrod, old boy, but those machines aren't very bright."

"Their onboards may be limited, but we both know they use the minsat for navigation and can plot their position to the nearest square meter. Bull and his people aren't very happy about these incursions. I told him I'd lodge a complaint."

"And now you have." He stroked his mustache as if in thought. "But I bet he wasn't as paffed about it as last time, was he?"

"No, not really," Joe admitted before remembering that honesty wasn't always the best policy. "Still, he's very concerned about the treaty being broken."

"It hasn't been." Testa waved his free hand as if shooing away the Guys's concerns like annoying insects. "Oh, it might get dinged up a bit here and there, but that's all. None of our gatherers have gone more than a klick or so onto their precious Coverture. You know that."

"I'm not sure the Guys would understand the concept of their treaty just getting 'dinged up a little,' Frank," Joe replied with more than a hint of sarcasm.

"Look, old chap," Frank said in a paternal tone, pulling his feet off the table and sitting up straight. Joe knew this meant he was going into 'fatherly advice given man to man' mode, and would try to make him feel like an uncertain neophyte. Which he was. "I know this is your first time in charge and you want to do it up right."

"I want to do right by my charges."

"Well, you are. Trust me, I've been doing this for over twenty-five years now, both on and off Earth, and this is the way things always work out here in the field. We strike a deal with the natives to get the ball rolling, then we do a bit of adjusting for windage to make sure it's headed toward our goal. Like here. I wasn't happy about letting such a large tract be declared off-limits, but they didn't seem to want to budge so I let it slide. The treaty says we can't go in there to gather, so we don't." He lowered his voice to a conspirational level. "But if one of our 'chines kind of accidentally nibbles its way onto the edges of all that land sometime, well, what's the harm?"

Again he was as much as saying it was done on purpose without actually stating it flat out. Testa was, as Joe's

LICENSED TO UNZ.ORG
ELECTRONIC REPRODUCTION PROHIBITED

mother used to say, *slicker than snot on a mitten*. "They see it as a violation," Joe answered stiffly. "Which it is."

Frank shook his head, his expression pitying. "Look, just because they yell about it doesn't mean a bloody thing. This is all a game, Joe. They bitch. We slip them a few extra goodies to make nice. After it's happened a few times we go to them and say, 'Sorry chaps, but we just can't seem to follow that line. Deuced nuisance, I know. What say we redraw it to save us all some trouble?' By then they're so used to us going over the line anyway, they'll figure their best bet is to get a good price for letting us have what we're already taking." He spread his hands, blue eyes twinkling in triumph. "Everybody wins."

Joe didn't know if he was supposed to argue against this version of operating procedure, or how. This was only his third posting, and his first as something more than a minor underling in a large office on a heavily populated planet. His rather loosely defined mandate was to act as an advocate for the natives and a buffer between them and BCT, and the only enforcement power he had was the ability to write a strongly written censure that would take months to get back to the Agency.

Most of his experience working in the bureau agreed with Frank's assertion that treaty terms were to some degree mutable. It seemed the best he could do was continue on the way he had so far—trying to keep the aliens happy while trying to keep from alienating Frank. He had the feeling that as an enemy, Testa would be serious.

"Everybody wins," he echoed. "I guess I can see that."

Frank beamed at him. "Stunning. Like I said, you're one smart chap."

"But maybe you shouldn't try to play the game so fast," Joe continued, playing this round of the game to manage at least a draw. "Bull and the others are at least as smart as we are. What you see as clever maneuvering they may well perceive as an insult to their intelligence."

Testa's grin stiffened, a spark of irritation, maybe even anger lighting in his eyes and then being pinched out. Joe knew he considered the Guys to be little more than smart animals, and he didn't like the implication that they might be smarter than he was. "Sure, Chief. I get the picture. Slow down the foreplay."

Joe found that an odd turn of phrase. It seemed to imply that sooner or later someone was going to get screwed. "I suppose you could put it that way."

Testa grinned and spread his hands. "Then call me Mr. Slow and Easy." He stood up and headed for the door. Halfway there he stopped, snapped his fingers, and turned back. "Ah yes, I was wondering if you could do me a smallish favor."

"Depends on what it is," Joe answered cautiously. Now he'd see what kind of strings were attached to that pack of *tlat*.

"Oh, it's nothing that'll compromise your position, don't worry about that. You know we have a supply ship coming, the *Tahiti*. It's already insys-

LICENSED TO UNZ.ORG
ELECTRONIC REPRODUCTION PROHIBITED

tem and should make orbit sometime this evening."

"I knew that." So far so good.

"Well, guess who's aboard? It seems that Serena Caltefores herself is coming to check out our little operation."

Joe frowned at the name. "Is she—"

Frank nodded. "That's right, she's the daughter of and heir to Ramon Caltefores, founder, CEO, and chief stockholder of BCT."

"Why's she coming here?"

Testa rolled his eyes skyward. "Probably to be an utter pain in the ass—boss' darling daughter and all that rot. The thing is, I'm going to have my hands more full than a blind strip club owner auditioning topless waitresses, and was wondering if mayhaps you'd give her a tour. You know, keep her out of my hair for a while."

Joe asked the obvious question. "Why me?"

"My people are going to be busy with incoming and outgoing shipments. You know this place as well as anybody, and a hell of a lot more about the Guys. All you have to do is squire her around a bit." He leered and winked. "Hey, this may not be a hot date with a sure thing, but what the hell? I've heard she doesn't look like much, but she is filthy rich. In my book a tart with that much jam in the bank could look like a bloody Guy—and I mean the kind that live here—and still be worth bush-logging."

While Joe found Frank's tone and attitude offensive, it had been almost seven months since he'd spent any time with an unattached woman. He decided that a rich, almost certainly spoiled rotten heiress like Ramon Caltefores's daughter would find an underpaid civil servant like himself particularly interesting. Still, a woman in her position must have some clout, and maybe he could convince her to make Frank take the Guys's borders more seriously—and wouldn't *that* roast Testa's ass? Besides, other than some paperwork, what else did he have to do tomorrow?

"Sure, I guess so," he said with more reluctance than he felt.

"Stunning! I owe you, Chief. We're supposed to get a full load of mail and supplies I need for prepping my shipments tonight. Her highness plans to descend sometime tomorrow morning. I'll have Mabel give you a ding when I have an exact time." He consulted his complet. "Speaking of time, I've got to run."

"Sure, Frank," Joe said, standing up and pretending that he too had just remembered something. "Oh yeah, don't forget you owe the Guys reparation for violating the Coverture."

Testa's grin froze, his eyes narrowing. Then he chuckled mirthlessly. "Sure, Joe. Will a Tier One release make you happy?" Tier One was the lowest level possible.

Joe returned an equally insincere smile. "It's the Guys we want to keep happy, remember?"

Testa let out a theatrical sigh. "Like you'd ever let me forget. OK, I'll go Tier Two. Will that repair the terrible damage I've done?"

Joe figured he'd pushed Frank as far as he dared. "That'll be fine. Send Petra the authorization and I'll check with her on the specifics."

LICENSED TO UNZ.ORG
ELECTRONIC REPRODUCTION PROHIBITED

"Will do, Chief." Testa went on out the door without even a cheerio or toodle-oo.

"Must be the foreplay is over for now," Joe said softly, finally taking a sip of his *tlat*. It had gone cold, which made it bitter and undrinkable. He went to dump it out and brew another cup.

After all, he did have a fresh supply.

It was delicious. He probably would have enjoyed it even more if he'd known precisely what it was costing.

Petra Davidovitch looked up from her design table when Joe stepped into the cool shade of the domed structure everybody called the Shop. A mischievous smile lit her pale face as she pulled her loupe off her head, leaving her curly, whitish blond hair corkscrewed in all directions.

"Hiya, handsome," she purred, tossing her head and adjusting the tab of her coveralls slightly downward to reveal more of her cleavage. "You here on business or pleasure?"

"Hi Petra," Joe answered with a shy smile. "Did Frank get hold of you?" Although happily married to Hakim Khassa, who ran the site testing lab and doubled as medic, she always greeted Joe like a femme fatale looking for a fling. He always pretended he didn't notice. Although she was fairly attractive in a wiry, flat-chested, tomboy sort of way, he wasn't going to let himself get into the double trouble of messing with someone who was married and worked for BCT. He even had BAA guidelines to back him up on this sensible course of nonaction.

"Business, huh?" she said with a rueful grin. "Yeah, he authorized a Tier Two release. Was he being bad again?"

"Same old thing, letting his gatherers stray onto the Coverture."

She shook her head. "Ah, greed, thy name is Testa. You must've had him over a barrel to get a Two."

Joe stared at her, realizing she was right. "I guess so," he muttered. The fewer and lower value the releases Frank made the better his balance sheet looked. That Two had come awfully easy.

Petra grinned and shrugged. "Hey, his loss is your gain. I'd been hoping a Two would come up and tinkered together something I think the Guys are going to love. Check this out." She led him back to a tarp-covered worktable. "The Guys are nuts about glass, right? It's a tech they never discovered, not being fire users. Corrective lenses were like a revelation to them."

"They sure were." One limitation of the imar bodies the Guys inhabited was that they were farsighted. The big predators' eyes were designed for spotting prey at a distance and were uncannily acute in that range. But once things got within a meter or so fine detail was lost—anything that close was as good as eaten anyway. The Guys had never considered the possibility that good near sight was even possible; outside an imar their sight was even worse than that. Joe had been the one to figure out their vision problem, and big tough reading glasses for every Guy had been the trade on which the treaty had been founded.

LICENSED TO UNZ.ORG
ELECTRONIC REPRODUCTION PROHIBITED

Petra laid her hand on the tarp. "Their distance vision is several times better than ours. But I got to thinking, what if they could really see far off stuff. So—" She whipped the tarp off with a flourish.

On the table were two heavy-looking meter-long tapered tubes offset in the middle and connected by some sort of lever mechanism. He stared at the thing a moment, then laughed. "Petra! You made them binoculars!"

She buffed her knuckles on her coverall. "Dead on. What do you think?"

Joe looked her creation over more closely. As with everything she fabricated, it had been designed with care and precision, and crafted to be both sturdy and beautiful. "These are great! But they're so big! How much do they weigh?"

"About twenty kilos. Cybonic ones would have been lighter and easier to produce, but I know the Guys are fascinated with glass and lenses. The prisms alone weigh two kilos each. Fortunately weight isn't much of a problem with this crowd. A Guy can handle these babies like they weigh nothing at all."

Joe shook his head in amazement mixed with increased respect for her skills. "The Guys already have a fairly sophisticated astronomy. Do you realize what these will do for them?"

"That's why I made 'em. Now these babies are Tier Two material, sure as shit. I couldn't show them to any of the Guys until I got a release. Now I need one to help me make final adjustments. I sort of had to guess on collimation and focal length—again, cybonics would have been easy to make self-adjusting, but these just seemed somehow right."

"They are. They're perfect."

"Almost worth having your borders violated for, huh?"

Joe gazed at her a moment, but saw no sign of that having been the sort of sly, insinuating remark Frank might have made. She was simply stating her belief that what she'd built would redress the violation in spades. And it would.

"Pretty close, anyway. I'll ask Longo to come give you a hand. He's one of their oldest sky-hunters, and already worships you for fixing it so he can see to make smaller charts."

"Send him around any time this afternoon. We'll get these tuned up and I can have a second pair made by tomorrow." She winked. "The way I figure it, Tier Two means we owe 'em two pair."

Joe took her hand and kissed it, both to express his admiration and to keep her guessing as to whether her flirting was making a dent. "Petra, you're a wonder. I can't thank you enough for taking the time and trouble to think up something that will actually enrich these peoples' lives." That last sounded like mushmouthed diplomatic boilerplate, but it was true.

She ducked her head modestly, almost shyly. "No big deal. It's just as much a treat for me to be fabbing something other than weapons and tin mirrors and cooking pots and crap like that. The Guys are good people. They deserve nothing less than the very best we have to give them."

Joe kept his smile, but his pleasure faded. "Yes they do," he agreed.

LICENSED TO UNZ.ORG
ELECTRONIC REPRODUCTION PROHIBITED

* * *

It was late, but Joe was still up, slouched in one of the office easy chairs, drinking tea and gazing moodily out at the night-shrouded landscape. Three of Marguy's five tiny moons were in the sky, providing a soft, somber light. Off in the distance a faint reddish glow marked the place where the Guys had a fire going. Fire was a new thing to them, and they still hadn't come to a consensus on what sort of terms it should be accepted. Most nights Nab, the Guy who had taken it on himself to study this strange human import, lit a small blaze. Others would come and go, studying it, contemplating it, communing on it and its implications. These deliberations—and there was no better word to describe this slow, cautious process—might go on for several more months before a decision was made.

He knew he should be able to consider the day a success. Frank's violation had been fairly redressed. Soon, if not already, Longo and his fellow skyhunters would be seeing things until now hidden from them, and so coming that much closer to understanding the cosmos around them. That was no mean gift.

Yet a sense of unease alloyed with his usual nagging self-doubt had been shadowing him since Petra's parting comment that afternoon. When his day's work was done he'd tried to lose himself in playing Bug Hunt, but his concentration had been so bad he'd made himself quit before he got even further behind.

He knew that playing it and pretending to be the sort of warrior/hunter his ancestry might have made of him was dumb. He wasn't that kind of Indian. Outwardly he might look like a full-blooded Mohawk, but inside he was a mutant his family had somehow produced. Not a sacred creature like a white buffalo, but the human equivalent of a rubber tomahawk or plastic dreamcatcher. Sometimes he wondered if maybe his mother had eaten too many Twinkies or TV dinners when she was carrying him.

He sipped his oolong tea, watching the distant bonfire, watching his own reflection in the perspyl.

He knew better than to romanticize the life his family led. There they were, living on the Rez, keeping themselves apart from a world they could not and would not adapt to. Making part of their living by being living anachronisms, caught in a peculiar temporal eddy that contained both traditional ways and 100-inch Hitachi HDs, wearing feathers in their hair while driving fusion-powered Fords, spearing salmon and sending out for pizza.

By age seven he'd known he didn't want to spend his life working in a Rezedge casino, or pounding drums, reenacting dances, and hawking baskets to tourists; painting his face and dressing up in the tattered and faded remnants of his tribe's culture. He wanted to go places, see and do things that had nothing to do with the world into which he'd been born. Teaching stories bored him, SpaceNet was what absorbed his every free moment. The first FTL ships were heading off to find other worlds around other suns! How

LICENSED TO UNZ.ORG
ELECTRONIC REPRODUCTION PROHIBITED

could he know that and stand to spend his whole life within the same few hundred square miles?

"So here I am," he whispered to his reflection. "Over 700 light-years from the Rez and I haven't touched a drum in years. The youngest BAA Station Chief ever. I'm my own man now."

Your own man. Using an office and living space provided by the company you're supposed to be watching, playing games on their cybonics, drinking high-priced tlat you get tossed like a bone to a dog, making excuses for them, letting yourself—

Joe flinched in surprise when his comm chimed. "Yeah?" he called, hoping it wasn't another Frank versus Bull bout.

"Joe? It's Jubal. Have you got a minute?"

"Sure what's up?" Joe sat up straighter, glad for the interruption. Jubal Atkins was the site factor, in charge of handling shipping and inventory. A middle-aged, quietly aloof black man who gave classes on fencing and classical guitar in his off hours, he was probably Joe's closest friend on Marguy. Joe had started out trying to keep from getting too chummy with BCT staff, but five months of lessons and a shared outsider status had created a surprisingly warm friendship. Joe was doing all right with the fencing, but was an absolute disaster as a guitarist. The two men were also the only teetotalers.

"I just got a shuttle load from the *Tahiti* sorted out, and there's some stuff here for you. I saw you hadn't logged off for the night, and figured I'd see if you wanted it sent up."

Joe glanced at the clock. Nearly midnight, but he couldn't say he felt much like sleeping. "Sure, that'd be great. I can come down and get it."

"Stay put. George is here and he's bringing some other stuff up your way shortly. Figure five minutes. That OK?"

"Sure. Thanks."

"No problem. Jubal out."

Joe realized there would probably be mail from his family. Maybe that was why he'd been thinking about them, unconsciously knowing he'd be hearing from them soon.

The agency had sent him a cybotic Kube no doubt stuffed with forms, and informed him that he'd gotten a 5 percent raise. The rest of his mail was from his family and pretty much what he'd expected: small talk, bits of gossip, reports on who'd gotten pregnant, married or divorced, tales of that winter's record-breaking snowfall; dispatches from their insular world. One benefit of his job was that the BAA would bear the cost of shipping small parcels to their agents. His family had taken advantage of this offer. His mother had made and sent a pair of beaded shearling moccasins and a knit sweater far too heavy to ever wear on Marguy. His uncle John had sent a kilo of venison jerky and a kilo of smoked dried salmon. His female cousins had sent StaPax of homemade blackberry and huckleberry jam, a packet of birch gum, and wintergreen leaves and sweetgrass for tea.

The package he left for last was the one from his grand-father, Samuel Swamp. Grampa Sam had been the

LICENSED TO UNZ.ORG
ELECTRONIC REPRODUCTION PROHIBITED

one to whom he'd first confessed his desire to do the things he never could if he stayed on the Rez. He had seemed the most likely to understand such feelings since he himself had gone off to take a doctorate in mathematics and spent years teaching at Caltech. Only in his late forties had he returned to his roots, coming back to the Rez, taking over the teaching of math at their own Reservation School and eventually becoming principal.

Grampa Sam had listened soberly to the young Joe pour out his hopes and fears and space-filled dreams. Then he had said that this was a most important matter, one which would take much thought before he could speak to it. He sent Joe home, telling him that he would have his answer in the morning. That night had been an agony for Joe. Samuel Swamp was one of his tribe's most respected elders. What he decided might as well be law because of the weight everyone else would give it.

When Joe awoke that next morning he found Grampa Sam sitting there beside his bed, smoking a cigarette and drinking coffee. He told Joe that he had thought long and hard on this matter. He had consulted with his ancestors and sought guidance from the spirits. What they told him led him to spend the rest of the night netrifying, racking up one ball-buster of an info-bill.

Joe's path was clear. He was being Called to be a new sort of warrior. There was a need for him in the wider world outside the Rez, and on the distant worlds as yet unseen. Men were going to these other worlds now, and soon they would be meeting the other Peoples who dwelt on some of them. This was good, and yet implicit in such a meeting was the possibility of great wrongness. Their own people had come in contact with people from another world, and had nearly been destroyed in the process. Some of that came from prejudice, some from greed, some from indifference to the welfare and ways of others, and much of it could have been avoided if only there had been less ignorance on both sides of this collision of worlds.

Worlds were funny things, his grandfather mused. Sometimes they rejected you, sometimes they never let you go, and sometimes they did both. As a young man the world and ways of the Rez had pinched him like a bad shoe, so he had gone into a whole other world off the Rez, and lived in a world within a world called Academia. It was a good place, yet for all the honor he had found there, in the end he had known that it was not really where he belonged. Returning to the Rez he found that it still did not quite fit him either, but it was where he was supposed to be. So he had remained there as one who dwelt between two worlds, with one foot in each. Maintaining your balance in such a position was quite often hard, but it could be done without falling on your ass too often.

This was to be Joe's lot as well, only in his case the worlds would be literal as well as figurative. There were people out there groping toward the creation of a means to provide people who would act as a buffer between

LICENSED TO UNZ.ORG
ELECTRONIC REPRODUCTION PROHIBITED

this world and its ways and those of the Other Peoples waiting to be met; to act as spokesman for these far-flung tribes, to be their friend, ally and guardian. Joe's task was to prepare himself to join this as yet uncreated agency and become a speaker and warrior in these other Peoples' behalf, a task for which he would have his grandfather's help.

The BAA had been officially founded when Joe was a junior in high school—first in his class thanks to his grandfather's tutoring. He applied to join just before finishing his masters degree. Attached to his application had been letters of recommendation from Indian Chiefs and world-renowned physicists, mathematicians and philosophers—again thanks to his grandfather.

Joe made a cup of fragrant sweetgrass tea before opening that last parcel, expecting one of Grampa Sam's usual dense, multipage, borderline textbook letters filled not with small talk but large ideas; letters which proved the old man was still dedicated to helping educate him.

The tea smelled of his childhood and tasted of nostalgia, making him feel like the little boy he had been again approaching his grandfather's knee. Yet this time the old man surprised him. The parcel contained only a small flat package with a short note attached. The note read: *My son, now your are in charge of a mission to a new People and have become an elder in your own right. A warrior for the Sacred. If you can only remember the lessons of history, and how they teach us the fragility of treaty and trust, you will be wise indeed. You do us proud.*

Inside the package was a hand-stitched doeskin vest, the leather the color of caramel and softer than velvet, the buttons slices of antler. Designs he did not recognize were painted on the breast and back. It was not newly made but very old, and had the feel of a well-cared-for relic.

He stood up and put it on, feeling slightly foolish, like he was playing dress up. The whole buckskin and feathers thing had never appealed to him. Yet the vest settled onto his shoulders and felt oddly right, like a lost belonging only now returned to him.

He fell asleep in his chair not long after, still wearing the vest. His dreams were of the hours he and his grandfather had spent huddled over one of the old man's many computers, stalking wily and elusive bits of information in the trackless cybotic wilds. In those dreams he smiled, for on that ground he was a hunter and warrior equal to any but the one who taught him.

Joe got up early the next morning, made coffee, and settled down into being a full-out flatbutt bureaucrat. The Kube the BAA had sent was indeed a daunting mass of cybotic forms which had to be filled out and sent back with the supply ship. Among other things he was expected to list every transaction, infraction and redress that had occurred during his tenure. That wouldn't have been so bad if they'd just wanted the dry bones of facts and figures. As station

LICENSED TO UNZ.ORG
ELECTRONIC REPRODUCTION PROHIBITED

chief he was also expected to give his assessment of the gravity of each instance where BCT had exceeded the bounds granted them by the natives, and his opinion as to whether it was accidental or a calculated attempt to infringe on their rights.

Sighing and cursing Frank under his breath with every third entry he filled out that part, struggling to maintain a balance between shooting straight and shooting himself in the foot—dancing around the facts like someone from an old Western dancing around the bullets fired at his toes.

The next part did give him some comfort. He was able to enter big beautiful *None's* in the section labeled NATIVES ACCIDENTALLY KILLED, WOUNDED OR MURDERED and HUMAN PERSONNEL ACCIDENTALLY KILLED, WOUNDED OR MURDERED. Human/Guy relations had been blessedly peaceful. He probably couldn't take too much credit for that, but it did prove he wasn't a total disaster at his job. Massacres on your watch didn't look good.

He was laboring over the section titled RECOMMENDATIONS when his comm chimed, that sound closely followed by Mabel's voice.

"Mr. Swamp?"

"Yeah?" he called, wondering at the sudden promotion to Mister.

"You have a visitor, sir. It's—" A hushed pause. "It's Madame Serena Caltefores." This last was spoken in the voice of someone announcing visiting royalty.

Joe closed his eyes and hung his head. He'd clean forgotten about his promise to play tour guide to the crown princess of BCT. Having spent much of the morning trying to justify their actions and his responses to them hadn't put him in the best of moods to deal with this.

But a promise was a promise, and there was no telling how someone like her might react to disappointment.

"Send her in, please." OK, he'd give her a whirlwind tour and hope she found it boring enough—or the Guys frightening enough—to want to go back to her nice comfy ship as fast as her high heels could carry her. He stood up and put a smile on his face.

The door opened, and the woman who entered was so unlike his expectations that his first thought was that she was some sort of aide or flunky. But the woman looked him in the eye, nodded, and said, "Hello, I'm Serena Caltefores," in a low husky voice as she headed toward his desk.

"Uh, hello," he responded lamely.

She reached his desk and offered her hand to shake. "You're Joe Swamp, right?"

"Joe Swamp. Yes ma'am. That's me." He gingerly shook her hand, then gestured toward a chair. "Please sit down, ma'am. If you want to, I mean. You don't have to or anything."

"Thank you. I will." She looked around, and oddly enough chose the hassock there for visiting Guys to use. The only reason he sat down was because of manners his mother had hammered into his head as a child. It wasn't really a conscious act; one moment he was standing, then next his chair was under his butt.

She regarded him solemnly. "I'm not quite what you were expecting, am I, Mr. Swamp?"

LICENSED TO UNZ.ORG
ELECTRONIC REPRODUCTION PROHIBITED

"Uh, no ma'am," he answered, his mouth seemingly on some sort of weird autopilot.

"You can dispense with the ma'ams. Please, just call me Serena. I'll call you Joe if that that's all right."

"All right, ma'am. Sure."

"You seem quite taken aback, Joe. Maybe even poleaxed. You aren't disappointed, are you?"

He shook his head hard enough to make his braided ponytail whip around. "No ma'am. Just kind of, um, surprised I guess. I'd kind of thought you'd be, well . . ."

"Lancier?" she supplied with a raised eyebrow. "Younger? Prettier?"

"Yeah—I mean, no—" He made a helpless gesture. "I just thought you'd be, well . . ."

"I'm quite well, thank you." She chuckled, a smile creeping out onto her face. "I'm sorry, I really shouldn't tease you like this. It's not fair, but it is fun. You look like someone who was expecting a visit from Cleopatra the Queen of the Nile and got a drag queen instead."

She sketched an ironic bow in his direction. "Yes, I'm Ramon Caltefores' daughter, heir to a gigabillion dollar business that spans entire star systems. No, I'm not exactly the pampered, fluffy little rich bitch you seem to have been expecting."

Her smile grew wider and a challenging note entered her voice. "I may be rich, and I'm sure there are plenty of people who think I'm a bitch, but I am not, nor have I ever been fluffy. I'm built like a truck and couldn't fit into anything under a size sixteen at gunpoint. I don't wear makeup or heels, I cut my own hair, and the only way I could win a beauty pageant is by bribing the judges."

She wasn't the glamorous young debutante he had pictured, but a woman his own age who looked like she could have come from the sort of-place where he grew up. Short, straight, glossy black hair framed a wide brown face that could only be called plain, with heavy dark eyebrows, a snub nose, and a wide mobile mouth. Her eyes were dark, short-lashed, and glittered with merry intelligence. Her build was wide-hipped and sturdy, maybe even chunky, her hands large and capable looking, her nails short and unpainted. In her baggy jeans, plain red T-shirt, worn multi-pocketed vest, and scuffed boots she could have easily passed for a farm wife or some other type who spent a lot of time outside, a park guide or naturalist maybe. One look and you knew she was solid, self-reliant, and utterly self-possessed. Her rugged appearance did nothing to detract from the air of earthy femininity he felt coming off her.

Joe wanted to tell this billionaire's daughter that she'd get his vote if he were judging any contest she entered, but was far too shy for that. Instead he tried to bootstrap himself up from being a mumbling idiot by playing host.

"Can I get you something?" he asked hopefully. "A soda? Some coffee or tea? I don't drink so I don't have any alcohol here, but Mabel could find you some beer or wine if you wanted." He hesitated, trying to guess what someone like her might want. "I kind of doubt they've got any cham-

LICENSED TO UNZ.ORG
ELECTRONIC REPRODUCTION PROHIBITED

pagne, but I do have some *tlat* if you'd like a cup of that."

At first his nervous stab at hospitality seemed to amuse her, then suddenly she gazed at him harder, her smile fading. "*Tlat,* huh? The BAA must be paying you pretty damn good if you can afford to drink that stuff." Joe swallowed, fairly sure the knot going down his throat was his foot.

She sighed and shook her head. "Sorry. I shouldn't be so rude. I know that our site managers customarily give goodies like *tlat* or good whiskey or whatever to the BAA agents they work with. Grease for the wheels of commerce, right?"

"I guess," he answered miserably. Why hadn't he just come right out and said *Oh, by the way, I take bribes from your company. Would you like some?*

"I can't even blame you folks for taking them. You're underpaid, underequipped, outnumbered, and all on your own. Small luxuries like this office I assume we're providing make your job more bearable. But I hate seeing it. The BAA and BCT have to get along, but getting too cozy opens the door to abuses on both sides."

Joe could only listen in abject silence, feeling guiltier by the second. She was right. He was pond scum.

She grimaced, then gave him an apologetic look. "And now I'm making you think I'm a bitch, too. Sorry, sermon's over. I'm not condemning you, Joe. You seem like a very nice man and I'm sure you're doing a good job here. Pretend I'm as nice as you, not some pushy broad with a chip on her shoulder." She stood up and smiled sweetly. "Could we pass on the *tlat* and get right to the tour? What I really want to do is meet the *guymarguyimaranguyital.*"

This woman was full of surprises. She'd used the name the Guys used for themselves and pronounced it perfectly.

"Uh, sure," he said, relieved that she'd let the other matter drop. "I'm ready if you are."

"So, Joe," she said as they exited the elevator and headed for the combination door and airlock leading outside. "You're Mohawk, aren't you?"

"That's right," he answered, taken off-guard by this sudden conversational turn. "How did you know?" To most everyone else all redskins looked the same. He had that same problem himself with Orientals. Even though he'd grown up seeing plenty of Chinese, Japanese and Korean tourists he still got them confused.

"I read your file. But even without that I could have told by your body type, your accent, and by that vest you're wearing. Which, by the way, is a really wonderful piece."

He'd forgotten he still had it on. "Thanks. My grandfather gave it to me."

"I'm sure you know that it's a sign he holds you in very high esteem."

"I guess," Joe answered unenthusiastically, knowing the old man didn't understand that his job wasn't the noble pursuit he thought it would be.

"The emblems painted on it tell me it belonged to one of the Salmon Warriors of the early twenty-first. They were a small pan-tribal group that ded-

LICENSED TO UNZ.ORG
ELECTRONIC REPRODUCTION PROHIBITED

icated itself to ecological preservation and renewal, beginning with their ancestral fishing waters and hunting lands. His giving it to you means that he considers you to be a warrior for and protector of the sacred."

He stared at her. "How do you know all that?" *When I don't.*

She chuckled. "I could have had myself announced as Doctor Serena etcetera, but I don't like sounding too imposing."

That made him snort. "Right. As if being the daughter of one of the richest men alive wasn't imposing. So you're a doctor, too? What kind?"

"Anthropology. I also hold degrees in Ethnobotany, Exobiology, and Exoanthropology."

So much for her being impressed with his measly MBA. The steel and perspyl door slid open in front of them and they went on out into the bright sunshine. The tropical heat and humidity rolled over them in a wave, carrying the scent of exotic flowers and rotting vegetation, the buzz of insects, the calls of Marguy's version of birds. Wrapped greenly around the clearing where BCT's operation was based was a jungle equal in fecundity to any Earth had ever produced. He watched her sniff the air and smile in anticipation.

"Those must be useful, um, disciplines for a woman in your position." There, he didn't always have to sound like a moron.

"They help, sure. But I didn't go Anthro because it would be a good career move—some stupid MBA would probably have been a better bet. I really love learning about new places and people and customs. It's a lot more exciting than shopping for the right clothes to wear to the right places so you can fit in with the right people." She looked around, obviously finding her surroundings more interesting than the topic of conversation. "Enough about me. Tell me about the *guymarguyimaranguyital.*"

"Well, to begin with, we call them Guys for short."

Her brow furrowed in a scowl. "Isn't that kind of demeaning?"

He shook his head. "No, that's what they told us to call them. You see, they understand that our language is much different from theirs, and we generally use a lot shorter words. They also told us shorter names to use for them as individuals. One Guy we'll probably meet is called Bull. His full name is," he took a deep breath, "*Bulaguymarguyhabulliskabullimarguydamar,* which even he admits is a pretty big mouthful."

She laughed. "I think he's right. I'll call the Guy Bull."

Joe headed them out along the eastern path which would lead to the place where Bull could be usually found, a small glade by a bubbling spring and pool. "So what do you want to know?"

"Everything. The dossier I was expecting on the natives and our arrangement with them somehow never made it to me, so I'm starting almost from scratch. Is it true that each Guy is actually two separate biological entities?"

"Sure is. When we see Bull we see the body of an *imarguymarguyakh,* the dominant land predator on this

LICENSED TO UNZ.ORG
ELECTRONIC REPRODUCTION PROHIBITED

planet's single continent. But the, um, *person* we talk to is a soft-bodied parasite that lives in a bony cavity on the underside of its head. I guess you could call that part the real Guy; alone, an imar is about as smart as an alligator and a lot nastier. Guys have certain telepathic abilities. In the beginning—or at least way back when—they used to survive by calling small animals to themselves, entering their bodies and scrounging what they needed to survive from their systems. Over time they got bigger and smarter, able to not only enter but control larger animals. Eventually they evolved to the point where they could take command of the imars, entering their bodies through the breathing slits just below the eyes and taking up residence in that cavity I mentioned. That puts them in contact with the imars' fairly primitive nervous system, and they control it like it was their own. That made them the dominant species because wild imars were no challenge to ones controlled by a serious intelligence."

"Do they still call imars like that?" she asked as they left the clearing and stepped into the leafy shade.

The Guy-made path they followed was wide and winding, the ground hard-packed and smooth. Because of his kind's preternatural awareness of their surroundings, Bull probably already knew they were on their way to see him. Everybody thought it was hard to sneak up on an Indian. Sneaking up on a Guy was just plain impossible.

Joe did his best to answer the question. "Yes and no. Guy offspring are born in nests now, and kept in domesticated brooders until they've grown enough to take an imar of their own. They maintain a stock of imars bred for biddability and more useful hands, but rebreed them with wild ones to keep the line strong. See, they have two kinds of sex: imar sex, to continue that breed; and Guy sex to make more Guys. Imars come in male and female, mate once about every two years, and the female lays a clutch of eggs. Usually only one offspring, the nastiest one, survives—its brothers and sisters become baby food. Guys mate only once or twice in their whole life—and they live to be well over a hundred. It takes two to mate, each Guy forming and finally producing a small blob of protoguy. The two blobs are put together, then the pair work together to shape its development. They're real deliberate about this. Humans put less time and thought into building a starship than Guys put into making a baby. Their population remains quite small and stable, with just under a thousand Guys alive at any time. Guy sex is—"

Serena put her hand on his arm to interrupt him and grinned. "Tell me, do you always talk about sex right after you meet a woman?"

Joe blushed. "No, I only, well . . ."

She patted his arm. "I'm only teasing you again. All this is fascinating, and I really do want to know everything. I don't believe you can treat another race with the proper respect, and do what is in their best interests, unless you understand as much as you possibly can about them."

LICENSED TO UNZ.ORG
ELECTRONIC REPRODUCTION PROHIBITED

He gave her a sidewise look. "I hope you don't mind me saying so, but that's a kind strange philosophy for someone from BCT."

"It shouldn't be," she said heavily, taking her hand away and staring straight ahead. "But it is. I lived with tribes in Southeast Asia, South America, Africa, and Arizona. I learned a lot about how other races have been treated both rightly and wrongly—mostly wrongly. I've had an uphill battle since I joined the family business. BCT has to change how it does business, and I intend to see those changes made."

"Does your father know how you think?"

She let out a humorless laugh. "Oh yeah. We've got an odd kind of relationship. He knows I think BCT cuts too many corners, bends too many rules, and treats the more primitive races no better than we absolutely have to. He knows I think things should be done differently, but figures working out in the field will make me see that the get-bys and sneak-arounds are what get us anywhere and bring in those profits."

She shook her head, her jaw set. "Well, he's wrong. The more of that sort of stuff I see, the more determined I am that BCT *will* change. I've even started privately lobbying the BAA to tighten up its rules and regs."

"The company bigwigs must really *hate* you." Joe blurted it out without really thinking.

She laughed again, sounding both amused and bitter. "They don't love me, that's for sure. They know that sooner or later I'm going to be in charge, and when things are done my way profits are bound to take a hit." She shrugged, as if being on the shit list of some of the most powerful people alive were an everyday thing. Which it must have been. "The way I figure it, once you've got a few gigabillion in your pocket being too ruthlessly greedy trying to grab more is just bad taste."

"That's sure the way *I've* always felt," Joe agreed, trying to keep a straight face.

She peered at him slantways, the corner of her wide mouth quirking upward. "Now I think you're teasing me."

Joe took her to meet Bull. He couldn't help but remember the first time he'd met a Guy. Although he'd been cloaked by a forcefield that could have protected him from anything short of a small tactical nuclear weapon, coming face to face with a 2 1/2 meter, 250 kilo, vaguely dinosaurine creature with hunting knife talons and a saber-filled mouth at the top of its head had been somewhat taxing to his toilet training. Some of that came from what the experts called *exoanxiety,* an atavistic fear from being in the presence of the truly alien. A lot of it came from another deep wired human response; the habit of judging if the Other was more dangerous than you, and by how much. One look at a Guy and he'd instantly known that he was outclassed. It could obviously go toe to toe with the biggest baddest predator his planet had produced in the last ten million years or so, and win the bout in about five seconds flat.

LICENSED TO UNZ.ORG
ELECTRONIC REPRODUCTION PROHIBITED

Serena had to be brave because she certainly wasn't stupid. She'd unhesitatingly walked right up to Bull, introduced herself like he was just some interesting looking person at a party, and within a very few minutes had him explaining how the Guys' loosely structured society worked. Her questions managed to be tactful and respectful, yet at the same time probing. By the time they moved on an hour later he'd learned things he'd never picked up during six months of dealing with them on a daily basis. Gentleman that he was, Bull never once brought up any of his race's complaints against her father's company.

Next he took her to meet Ard, a practitioner of an art the Guys called by a name that was exceptionally long even for them. Humans called it *morfing*.

The range of lifeforms on Marguy's single small continent was bewilderingly diverse, far more so than the standard models would predict. That was because there were jokers in the evolutionary deck, namely the Guys. Using some as yet unquantified ability certain individuals possessed, the genetic makeup of existing flora and fauna were altered to create entirely new species. Some were created on purpose as pieces of self-replicating biological technology, others simply because their creator thought they might be interesting or beautiful.

This suggested the tantalizing possibility that at some point the Guys might be willing to create custom biota exclusively for BCT. Joe couldn't understand why, with this at stake, Frank seemed so willing to risk alienating them. He could only assume Testa smugly believed that because of his natural superiority the wogs or whatever he privately called the Guys would sooner or later give him what he wanted anyway.

Serena had sat with a stillness which would have made an Indian hunter proud for almost an hour, her entire being focused on watching Ard work, even though there was really nothing to be seen because the changes were being made at the chromosomal level. In spite of that she found the experience as exciting as a game of polo or whatever it was her people watched, and was in high spirits as they went back to the BCT site for lunch.

The hour Joe had planned to give her had already turned to almost three, and he was willing, even shyly eager to spend the rest of the afternoon with her as well. Sure, she kept saying things that made him and the BAA look bad, but it wasn't from some rich snotty viewpoint. She genuinely accepted the Guys as equals and felt that they deserved, like Petra had said, nothing but the very best her race had to offer.

He figured that after lunch they could do a bit more touring, and when the time seemed right he could bring up the matter of Frank's continuing violations of the Coverture. He had a feeling that she'd land on Testa like a ton of bricks. He could have told her then and there, but he couldn't help wanting to stretch out their time together as much as he could first.

But halfway through their meal she got paged by Frank and he got a call

LICENSED TO UNZ.ORG
ELECTRONIC REPRODUCTION PROHIBITED

from Mabel saying Petra wanted to see him ASAP. So they went their separate ways with an agreement to get back together later.

The way that had come about was her simply saying, *We'll get together later,* while Joe was still figuring out how to suggest that very thing. She seemed to take his saying yes for granted. So that's what he said, feeling both relieved and unnerved that she seemed almost as interested in him as the Guys.

It was probably professional interest anyway.

Petra was in a foul mood when Joe arrived. He found her storming around the Shop in a fury, rifling through the shelves and cursing in at least three languages. She had a hammer clenched in one fist and seemed intent on finding something to pound to smithereens.

"What's up, Petra?" he called from what he hoped was a safe distance.

She whirled toward him, her face contorted with rage. "Thanks a lot, you bastard," she snarled, brandishing the hammer.

Not only was she royally pissed, it was at him. He walked toward her as if he had nothing to fear, but did keep one eye on that hammer. "What did I do?"

"What did you *do?*" she mimicked. "Don't bullshit me! If you didn't think the Guys should have those binoculars you should have *said* something yesterday afternoon!"

He figured he was as close as he dared get. "Petra, I don't have any idea what you're talking about."

"Come *on!*" She flung the hammer like it was a war-hatchet, but at least it hadn't been aimed at him. Instead it crashed into the wall on her left, destroying her very first prototype for Guy-adapted spectacles. She stared at the shattered memento, her hands curling into fists, then her gaze swung back toward him.

"Petra," he said soothingly, "Please calm down. Tell me what the problem is. I really don't know what you're talking about. I thought the Guys would have those binoculars by now, and I don't know one reason why they shouldn't."

He watched her try to rein in her anger. "OK," she growled, "You tell *me* what's going on. Longo came in yesterday afternoon to help me fine tune 'em. I thought he was going to bust when he understood what it was they did."

She grimaced and ran her fingers through the stiff springs of her hair. "I found I'd made one small design error. Their eyes are a lot more light sensitive than ours are, and don't react to too much light very quickly. Those binocs have big efficient lenses, and there was no way they were going to be able to use them safely in the daytime. So I rigged a set of temporary filters to use while we made the other adjustments, then told him to come back around noon today and I'd have two pairs with photoreactive lens coatings ready for him to take."

Talking tech had seemed to calm her some, but now she glared at him and thrust out her jaw in challenge. "Just after he got here Frank called and said *you* told him I wasn't to let

LICENSED TO UNZ.ORG
ELECTRONIC REPRODUCTION PROHIBITED

him have them after all. Longo got real upset. I didn't think Guys could cry, but I swear to God that's what he was about to do. So I told him to give me some time to straighten this mess out, and he'd get his binoculars one way or the other." She put her hands on her hips. "Well?"

Joe shook his head, baffled by Frank's actions. "This is all news to me, Petra. I'd be willing to let the Guys each have a pair if BCT was willing to foot the bill."

She scowled. "You're saying Frank's jerking my chain with this crap? But why?"

That was a very good question, and one he intended to have answered. "No idea. But I intend to ask him wh—" He stopped midword, listening intently. "Do you hear that?"

Petra cocked her head, then nodded. "Yeah, it sounds like the flitter taking off."

Now it was Joe's turn to get mad. "What the hell is *that* doing going up? Everybody knows the Guys hate the damn thing." The Guys weren't particularly fond of human vehicles in general. The small VTOL flyer BCT had brought along had been banned from use because its turbofans made a high-pitched whine they found physically painful. People couldn't hear it, but Guys couldn't shut it out.

Petra shook her head. "I don't know why anyone would need it. I thought it was locked up tight."

"It's supposed to be. I better go find out what the hell is going on around here." He headed for the door planning to kick someone's—namely Frank's—ass up around their ears.

"What about Longo?" Petra called after him.

He paused by the doorway. "Give him the two pair you made and promise him a third for the racket. That OK?"

Her face lit with pleasure. "All right! Thanks, Joe!"

He waved and hurried on out the door. At least she was happy. The Guys—except maybe for Longo—were going to be another matter. Whoever took that flitter up was going to be one sorry puppy.

By the time he got outside the flyer was a dwindling silver spark above the treeline.

A spark headed straight for the Coverture.

Joe broke into a run.

The operations shack was locked up tight and Frank was nowhere to be found. Joe tried calling him but got no answer.

He did find Jubal in the warehouse next door, using a telelift to place racks of stasis-fielded specimens in a shipping container to ready them for loading in the shuttle parked outside. He had his nimble guitarist's hands in a pair of control gloves, a loupe on his head and a pair of headphones over his ears. Knowing that he'd never make himself heard over the loud classical music Jubal customarily listened to while working, Joe tapped the thin black man on the shoulder to get his attention.

"Have you seen Frank around?" he asked when Jubal powered down the lift and pulled the headset off.

He shook his head. "Not in a while. What's up?"

LICENSED TO UNZ.ORG
ELECTRONIC REPRODUCTION PROHIBITED

I'm trying to find out who took the flitter up, and why."

Jubal scowled and began shucking the gloves off his hands. "Dammit, everybody knows that thing's supposed to be off limits, and I mean . . ." His voice trailed away and his face took on the look of someone who'd just had a very bad thought. "Oh hell," he said softly.

"What?"

"The last I saw Frank he was with Ms. Caltefores. They were, well—"

"No, don't tell me," Joe begged, already able to guess what he was going to say next.

Jubal nodded soberly. "Yeah. They were headed toward where it's kept parked. But—" Before he could say anything more the complet strapped to his wrist erupted in a shrill beeping. The factor whipped his arm up and stared at its small screen. What he saw made his dark complexion pale. "We've got a problem, Joe," he said heavily as he pushed a button that silenced the noise.

"What happened?" The look on his friend's face made him brace for the worst.

Jubal looked him in the eye. "That was an emergency signal from the flitter. I think it just crashed."

The two men raced to the operations shack only to find it still locked up and Frank nowhere around. Jubal tried to open the door with his keycard but it was refused.

Just as he was about to try a second time they both became aware of a sound like distant thunder, a low subterranean rumble they could feel through their feet. It rapidly grew louder, and moments after they turned in the direction it seemed to be coming from, Bull burst from the solid wall of jungle and into the clearing.

Everyone knew the big aliens could move fast if they wanted to, but neither man had ever seen one in a real hurry. It was a fairly daunting sight. Bull thundered toward them at a good sixty kph, massive lower legs pistoning and the toe talons on his feet throwing head-sized clods of turf three meters into the air behind him.

"I sure hope he's calmer than he looks," Jubal breathed. In spite of themselves they stepped back and closer together.

Bull came to a halt before them with a deadly speed and surprising grace, and when he spoke his voice gave no hint that his high-speed dash had cost him any particular effort.

"I must inform you of an extremely grave situation, Mister Joe," he said. "Our treaty has been most grievously broken."

Again there seemed to be a sort of grim inevitability to what Bull said next. Joe could hear it coming and do nothing to change or stop it.

"Your nasty-noisy flying machine has not only violated the border of the Coverture, it has landed in a most inconsiderate and destructive fashion, causing dreadful harm."

Joe was fairly sure Bull didn't understand that it had crashed. "I accept your protest, Bull," he said in the most even tone he could manage. "I assure you it was an accident. The machine did not come down on purpose, but fell from the sky. Redress for

LICENSED TO UNZ.ORG
ELECTRONIC REPRODUCTION PROHIBITED

the border violation will be made, I promise you that. But first we must find out exactly what has happened, and who is involved."

Bull regarded him solemnly, then nodded. "That is both fair and reasonable."

"To do that we have to raise the flitter."

The Guy cocked his head. "Raise the flitter? Make it go up into the air once more?"

"No, I mean speak to it with our communications equipment. To do that, we have to get inside this building." He could feel time flying by, but there was no hurrying a Guy.

"Pardon my misapprehension of your meaning, Mister Joe. Am I constituting an impediment to your going inside?"

Joe shook his head. "No, the door is locked. We can't get in."

Bull pondered this a moment. "So you are saying that this door presents an hindrance to an expeditious resolution of this situation?"

"I guess you could say that."

"Then it must cease." Bull turned toward the shack, took hold of the door by burying his finger talons in the ceramaplast panel, then wrenched it off the building frame and all.

Joe made himself smile. "Thank you, Bull. That was, um, very kind of you."

"It was nothing," the big alien answered without a trace of irony. He turned toward Jubal. "Mister Jubal, I believe this is property of your company. Where would you like me to put it?"

Jubal gave Joe a wide-eyed glance, then gestured vaguely. "Oh, anywhere is fine, Bull. Really."

The Guy laid the twisted, punctured panel carefully aside. "May we proceed now that our way is no longer barred?"

"We sure can," Joe answered, motioning Jubal to go in first.

Jubal had gone immediately to the site operations communications base station and started trying to raise the flitter. After a minute or so with no results he turned the chair over to Joe and seated himself at the workstation across the narrow aisle. Slipping on a combination headset and loupe he began the process of instructing their commnav satellite orbiting overhead to locate the downed craft.

Joe had slid into the comm center chair after him, pulled on the headset and begun trying to raise the flitter. He had begun with a standard *Base to flitter,* but a fearful certainty as to whom he was trying to contact soon changed that to a more direct and fervent approach.

"Joe to Serena," he called, *"Come in please! Can you hear me? Please answer!"* He repeated that over and over, trying to will a response. None came.

Either three minutes or three hours passed, probably the former but it felt like the latter. Just as he heard Jubal mutter, "OK, I think I've got you now," a crackle of static lanced into his earpiece and came over the speaker. On the heels of that noise came a moan.

"Serena," he said tightly, trying to remain calm. "Can you hear me? Please answer." There was no picture on the comm's display, but he could hear breathing. *He could hear breathing!*

LICENSED TO UNZ.ORG
ELECTRONIC REPRODUCTION PROHIBITED

Another moan, then a cough. "Hi, Joe." More coughing, then the sound of her hawking and spitting. "Sorry."

"It's OK. Are you hurt?"

A few seconds hesitation. "'Fraid so," she admitted at last.

He swallowed hard. "How badly?"

"Bad enough. One leg is broken in a couple places and the other one is *really* messed up. I had kind of a rough landing. Me and this crate both got pretty trashed." She coughed again. There was a wet, bubbling undertone to it that made his shiver. "I think maybe I've got a couple broken ribs jammed into one lung, and I can't feel much of anything from the waist down." She spat. "But that's not what's really worrying me. It's that other thing."

"What's that?" he asked tonelessly.

"The imar staring at me through the canopy. I figure it's an imar because a Guy would've said hi. Now I'm no expert, but I've got this bad feeling that he might just be looking me over and thinking about lunch."

"Hang in there a minute," Joe replied in a flat voice. "I've got to go off, but I'll be right back. OK?"

"I'm not going anywhere," she answered with a phlegmy chuckle. "I'll see if I can get the pictup working."

"That's great, Serena. You do that."

He covered the headset's mike with his hand and turned toward Jubal and Bull. "Now what?"

"Human flesh is inedible to an imar," Bull answered in a serious tone. "Eating any will make it sick."

"That's a relief," Joe breathed.

Bull shook his head. "Regretfully I must inform you that it can only learn this the hard way, by eating some and getting quite ill."

"Oh man," Joe groaned, feeling sick himself. "Jubal? Any ideas?"

The factor glanced back at the workstation screens. "I got a lock on her. The flitter went down about twenty klicks into the Coverture, say forty klicks from here. We've got a gatherer maybe two from the border in that general area. It could get to her in maybe two hours if we were lucky, but she doesn't sound in any shape to get herself out of the wreck and into it."

Bull shook his head. "No gatherer may enter the Coverture. That is forbidden under our treaty."

Joe never got a chance to argue this pronouncement because Frank finally turned up, bursting in at a dead run and squeezing past Bull with a scowl.

"What the fuck is going on here?" he puffed.

"Serena crashed the flitter," Joe began, "And she's—"

"Dumb fuckin' princess," Frank sneered, all trace of his posh accent gone. "I told her she couldn't, but I guess when Daddy owns the company the rules don't apply." He jerked his thumb at Jubal. "Out. I'm taking over. I don't get her body back her father will have my nuts in a vice."

"She's badly hurt but still alive," Jubal explained, vacating the chair at the workstation.

Testa stared at him a moment. "Rich and lucky," he growled. "Must be nice."

Jubal shook his head. "I wouldn't call her that. She's got an imar giving her the eye."

Testa hesitated for a second, his

LICENSED TO UNZ.ORG
ELECTRONIC REPRODUCTION PROHIBITED

face going absolutely blank, then took the chair. "You two stay out of my hair and fuck with the imar," he snarled, jamming the headset on and turning away. "I'll work on hauling her useless ass out of there."

Joe turned back toward the comm-board and uncovered the mike. "Serena? You still with us?"

"Still here. I think I've almost got—oh boy, *that* hurts. OK. Got a picture now?"

"I do," Joe answered, his insides clenching with the effort it took to keep the dismay he felt off his face. She was a mess. Her face was cut and bloody, one eye swollen shut. Fresh red blood marked her mouth and nostrils, dripped from her chin.

"Not too pretty, huh?"

"You look just fine, Serena."

"You should get out more." She grimaced. "I should get out less. Remember me saying I wanted to know everything? Well, I have learned something new."

"What's that?"

"Yelling at an imar won't scare it away." She coughed, wiped her mouth. "'Course I can't yell very loud."

Bull moved closer. "You must not yell, Miss Serena. Almost any sort of loud sound will only draw its attention."

"What about the turbofan in the flitter?" Jubal suggested. "Would that scare it off?"

"It would find that most unpleasant." Bull confirmed.

"Did you hear that?" Joe asked. "Can you fire up a fan?"

"Sorry, but all the engines are dead." Joe couldn't believe how calm she sounded. "They crapped out on me in midair and I dropped like a rock." She shook her head. "I've flown these things lots of times and never had one act like this one did."

Frank pulled his headset off and pushed back from the workstation. "I'm going after her. You stay here."

"How?" Jubal asked.

Testa ignored him, shoving past Bull and on outside.

Joe flinched as the comm brought them a new sound. It was the imar scratching on the flitter's fuselage. On the screen Serena hunched lower, her jaw set.

Joe tore his gaze away and faced Bull. "There has to be *something* we can do to scare that imar."

"If one of us were in the area he could influence its small mind and frighten it away. But none of us are anywhere near that part of the Coverture."

"Could you do it from here?"

Bull shook his head. "No, it is too far away. My mind cannot push that strong a thought into its small brain from this distance."

"Damn." Joe scrubbed his forehead, trying to pull some sort of useful thought out of his own small brain. Nothing came. If only there were more people working on the problem then maybe—

His eyes went wide and he stared at Bull. "OK, how about this? You can link minds, right? That's what you do when you commune. Can you—can several of you all try to drive it away at the same time? Would that do it?"

Bull regarded him steadily, precious seconds ticking away before he an-

LICENSED TO UNZ.ORG
ELECTRONIC REPRODUCTION PROHIBITED

swered. "A most intriguing idea, Mister Joe. I do not know if it would work or not."

"Will you try?" It was all he could do to keep from screaming the question.

"*Joe!*" Serena rasped, "It's going to—" There was a distant thump and groan as the imar assaulted the damaged airframe.

Again there was that maddening deliberation before Bull answered, but when he did Joe wanted to kiss his big ugly mug.

"We are attempting this," Bull said slowly. "It is a new and fascinating idea. Miss Serena has trespassed against us, but we do not wish her to be further harmed. To frighten the imar we must cause a simple pulse of primal fear. To have many send such a pulse as one is difficult." He cocked his head to one side as if listening, and in the silence they heard the sound of the imar's talons tearing at the perspyl canopy, seeking a crack it could get hold of. "Others join in. We seek—"

The shriek of tormented metal, plastic and ceramic filled the room. "The dumb bastard is finally figuring it out," Serena whispered. How could she sound so calm?

"Joe," Jubal called in a low tight voice.

Joe held up his hand for silence, asking Jubal to wait. He didn't want anything to break Bull's concentration.

"Ah," Bull said softly. "Clever. An aid to synchronization." His foot began to thump rhythmically in a beat not unlike the drumming of Joe's childhood. Joe fought down a crazed urge to chant along. The operations shack shivered with each beat of Bull's massive foot.

Seconds later a bloodcurdling scream came over the comm, a shrill sound of absolute terror. Joe turned back to the commboard. The screen was black, blank. *"Serena,"* he bellowed, *"Are you there? Answer me!"*

There came a sound so unexpected that for a moment he couldn't figure out what it was. She was—

"You're. . . *laughing?"* he whispered with baffled disbelief.

The picture returned to his display, showing her hand receding after uncovering the pictup. She'd covered it so they wouldn't have to watch her get eaten. What kind of woman would do something like that?

"It ran," she gasped breathlessly, tears rolling from her eyes. "It jerked straight up like someone had booted it in the ass, let out a scream, and ran away so fast it nearly fell over!"

Joe sagged back in the chair. "Thank god." He smiled at Bull. "Thank you. Thank everyone."

"Joe," Jubal called again. "We've still got a problem."

Joe turned toward him. "*Now* what?"

"Frank took off in the shuttle. He's running it on manual, and he's using it to go after Serena."

"What's wrong with that?"

Jubal cut a meaningful glance in Bull's direction. Before he could say it out loud Bull said it for him.

"Mister Joe, your quiet sky-flying machine must not go over the Coverture, nor can it be allowed to land there. To do so would be in direct violation of our treaty."

LICENSED TO UNZ.ORG
ELECTRONIC REPRODUCTION PROHIBITED

* * *

The ensuing silence was finally broken by Serena.

"I heard that. What's he talking about?"

Joe answered her, his gaze still fixed on the big alien's face. "You've crashed in an area called the Coverture. The terms of our treaty make it off-limits to us and our machines."

"This is news to me. Not very good news, either."

He looked Bull in the eyes. "Please. This is an emergency."

"The emergency exists only because our treaty was broken in the first place. Breaking it again can only compound the damage."

"Frank's almost halfway there," Jubal reported tonelessly. "I think I can override his control from here if I have to."

Bull spoke calmly, passionlessly. "He must not be allowed to land. If you are truly our advocate then you must stop him."

Joe turned back to look at Serena and took no comfort in what he saw. She wiped her mouth and sighed. "Joe, tell me the truth. Did I break their treaty by flying out here?"

"Yes," he said softly.

A slow nod. "Then you must not break it again."

"Frank's almost there," he argued. "He can have you back here in short order. Hakim is a damn good medic."

She locked eyes with him. "You heard what I said, Joe. I never would have done this if I'd known. I apologize for my crime against them, and I will abide by their decision."

"Frank's four klicks out and closing," Jubal put in. "ETA in two minutes."

Joe swallowed hard. "You could *die* before we figure out some other way to get to you. If we even can."

Her gaze was unflinching. "How many of your people died because of broken treaties, Joe? Remember what you are, and the lessons of your history. You either stand for honor and trust, or you stand for nothing. Remember that vest your grandfather gave you. It's a symbol of honor and courage, of protection of the sacred."

"One minute, thirty seconds," Jubal intoned.

She shook her head, her gaze still pinning him mutely in place. "Don't cut corners, Joe. Don't take the easy way out, nothing good can come of it. A treaty is a sacred trust. I will not be a party to seeing it broken."

Joe closed his eyes, and perhaps because of her suggestion or just to find some kind of comfort, his fingers caressed the soft old leather of the vest Grandpa Sam had given him. But the old man had been wrong. He was not a warrior, nor was he wise. Not a real Indian, but a bleached-out bureaucrat hundreds of light-years from his people and their ways.

His grandfather had said he would be a man between worlds, and in this he had spoken a terrible prophecy. Now Joe was trapped in the place where worlds collided. It would be so easy to say *screw the treaty,* to tell himself that an artificial construct was less important and less valuable than this strange and courageous woman's life. As easy as all the other arguments, rationalizations, and excuses used to

LICENSED TO UNZ.ORG
ELECTRONIC REPRODUCTION PROHIBITED

bend and break the promises made to other Peoples in humanity's entire shame-filled history of seeing such pacts struck, broken and restruck—

—Sooner or later leaving one party with their lands and rights gone, and the other richer by the others' loss but diminished in honor. He knew his own moral and ethical pockets had already been lightened by the six months he had spent here. Was this the day, the hour, the moment when he finally declared bankruptcy, even if for the best of reasons?

Or was this the place he made his stand?

"Stop Frank," he said in a low, toneless voice. Jubal whirled back toward the workstation's boards and began trying to assume control of the shuttle.

"I'm sorry, Serena," he said, finally opening his eyes to look at the woman he had just condemned.

She managed a smile. "Don't be. I'm proud of you. You did the right thing."

A humorless laugh escaped him. "Did I?"

"I'm having some problems here," Jubal put in, his voice tense. "I'm trying to override Frank, he's trying to override me. So far we're deadlocked. The shuttle is just hovering, waiting for clear instructions."

"Have you tried contacting him? If she says stay away, he has to follow her orders, doesn't he?"

Jubal shook his head, touching his earphone. "I've told him that, but he's not responding."

"That son of a bitch," Joe growled, suddenly furious. "He never should have allowed her to take that flitter. I don't give a shit *whose* daughter she is."

"Joe?" Serena called.

"I'm here." Damn, she'd heard that.

"Frank *asked* me if I wanted to take the flitter up."

He turned to stare at her image. *"What?"*

She nodded tiredly. "That's why he called me. When I got there he said it wouldn't be needed for an hour or so, and was mine to use if I wanted to see this place from the air—which was really the best way to do it." A crooked smile appeared. "I would've liked you to have come with me, but you were busy and I didn't want to miss my chance. Now I wish I had."

That didn't make any sense. "Frank didn't tell you that we never use the flitter because the noise it makes hurts the Guys' ears? Or that the Coverture is restricted?"

She shook her head. "Not a word."

This was making less and less sense all the time. What was Testa up to anyway? "Jubal, how are you doing?"

"I'm not winning, but I haven't lost yet either. Frank just keeps shouting threats, demanding that I let him land. Now he's—damn, he's gone now."

Joe was beginning to wonder if rescue was what Testa really had in mind. The whole thing stank. If she was telling the truth—and he had no reason to doubt her and every reason to doubt him—then Frank had arranged for her to be in that flyer and over the Coverture. *Tricked* her into it. "Jubal, you've got to keep him away from her any way you can. Contact the supply ship. Maybe they're better equipped to override the onboard controls."

LICENSED TO UNZ.ORG
ELECTRONIC REPRODUCTION PROHIBITED

"Gotcha. What should I tell them?"

"Tell them—" He hesitated. "Tell them we're going to have a major interspecies incident on our hands if he lands."

Bull stepped closer and gently laid a taloned hand on Joe's shoulder. "I would speak to you about this situation."

The big alien had been so quiet Joe had almost forgotten he was still there. He covered the mike with his hand. That way if he had to tell Bull or Jubal what he suspected, she wouldn't hear him. She had enough problems as it was. "Sure, Bull. We're trying to do what you want."

"This I can plainly see, Mister Joe. You are doing everything in your power to avoid abrogating our treaty. For this I commend you." He gestured toward the screen. "I also see how badly you wish to remove Miss Serena from her present unhappy circumstances. We hold our treaty with you in high regard, and yet our relationship with you is no less valuable. The treaty is but a thing, while she is an extremely interesting person in a dire situation."

He shook his head slowly. "We have communed on this conundrum. Our rights are of cardinal importance to us, but we would not have you think us uncaring monsters. We have agreed that if it is indeed necessary for Mister Frank to land so that Miss Serena may be saved, then you have our leave to do so."

Joe couldn't help himself and started to laugh. It wasn't happy laughter, and it made Jubal turn and give him an uneasy look. *The redskin finally cracked under the pressure.*

Bull cocked his head and scratched his braincase. "I do not understand your amusement, Mister Joe. Is this relief?"

Although his race did possess a sense of humor, Joe didn't think it extended to irony. "Thank you, Bull, and forgive me. I laugh because I nearly tore myself in half choosing to stick to the treaty, and I now suspect I made the right choice for a whole other set of reasons. You see, I think that maybe Frank—"

Jubal broke in. "Joe, I have Captain Tsao from the supply ship. She isn't happy, and wants to talk to whoever is in charge." He gave an apologetic shrug. "I think that's you."

"Put her through." He glanced at Bull. "Let me deal with this and I'll finish explaining." The Guy nodded soberly and stepped back. Joe uncovered the mike and prepared to deal with this new crisis. That meant Serena would hear everything after all, but he didn't want to leave her without the comfort of hearing a human voice any longer.

An Oriental woman of late middle age appeared on the largest of the workstation's screens. Her iron-gray hair was pulled severely back and gold tabs gleamed on the high collar of her jacket. Her face was stern and forbidding.

"Who is in charge here?" she asked in a flat, no-nonsense tone when she saw that she'd been put through. Jubal eased back out of the way, leaving Joe pinned by her cold gaze.

"I guess I am, Ma'am," he answered after taking a quick check on Serena. Her head was back and her eyes were closed. Only the clenched look of

LICENSED TO UNZ.ORG
ELECTRONIC REPRODUCTION PROHIBITED

pain and fatigue on her face told him she was still conscious. "Joe Swamp. BAA Station Chief."

"Mister Swamp, I was just contacted by Site Director Testa. He informed me that you are preventing him from landing our shuttle and rescuing Ms. Caltefores." She made it sound like an indictment.

"We are trying to prevent him from landing, Captain. I have reason to believe that he means Serena—I mean Ms. Caltefores—harm."

Her eyes narrowed. "That is a serious accusation, Mr. Swamp. You had better be prepared to back it up."

"Yes ma'am, I know, and I admit I'm not in a position to prove it right this moment. But his actions have been highly suspicious. He offered Serena the use of the flitter in violation of both site policy and the terms of our treaty with the natives. He did not inform her of our rules against using the flyer, or that flying over an area called the Coverture would be a serious violation of our treaty. I find this disturbing, especially in light of her well known scruples against even slight violations. She would have been aware of these terms in advance, except that the information packet she was expecting never arrived—again an 'accidental oversight' on Testa's part. There are other things he did, such as having me conveniently sent on a wild goose chase to give him privacy to make this offer, but that should be enough to make you doubt his intentions."

The captain's expression had not changed in the slightest during this recitation. "Incompetence is not malfeasance, Mr. Swamp. These issues you have raised will be investigated, I promise you that. But as I understand it, he is the only person in position to rescue Ms. Caltefores. At this moment her safety is my prime concern."

"Ours too, ma'am. But I have a bad feeling that she might not survive her rescue attempt."

Tsao's dark eyes bored into him with an intensity that made him want to squirm. "Are you suggesting that Director Testa might cause her further harm, Mr. Swamp?"

"I am. I believe her accident was arranged by him, and that she was not supposed to survive it. Even if she did, he was counting on a wild imar—a deadly local predator—to be drawn to the crash site by the sound of impact and finish the job. An imar almost did get her, a tragedy averted through the actions of the very natives whose treaty this action will ignore. Even if he doesn't dare make what could be judged a understandable if sadly fatal mistake extricating her from the wreck, rescuing her by means in flagrant and willful violation of the treaty will irrevocably damage her reputation and standing inside BCT."

Captain Tsao shook her head, still unconvinced. "My concerns are not with her standing and reputation, but with her life. Lacking clear and compelling evidence of wrongdoing on Director Testa's part, I have no choice but to allow him to land. What I will do is make him aware that his every move is being watched, and that he dares not make any mistakes, fatal or otherwise."

LICENSED TO UNZ.ORG
ELECTRONIC REPRODUCTION PROHIBITED

Joe had to assume that one or several corporate high-rollers were behind the attempt on Serena's life, and Testa would count on them to protect him. Besides, she would be the best witness against him. He couldn't take the chance, and was running out of arguments. "Captain Tsao," he said, not quite able to keep the desperation he felt out of his voice. "As BAA Station Chief I must protest this proposed violation in the strongest possible terms."

"Your protest is noted. Now if you will excuse me—"

"No, you are not excused, Captain."

Joe turned to look at the commboard. Serena's eyes were open. She gave him a weary wink, then spoke again, not a single trace of weakness in her voice. "Did you hear me Captain Tsao? I said you are not excused."

The older woman glanced offscreen a moment, then turned back. "Is that you, Ms. Caltefores?"

"Yes it is, Captain. Now hear me. I absolutely forbid you to allow that shuttle to land. Do you understand me?"

A pained look appeared on her face. "Yes ma'am, I do. It's just that your father—"

"There is nothing to argue about, Captain. I would rather die than knowingly dishonor the pact my father and our company has made with the people here. We are either people of honor and principle, or we are nothing. I will not allow you to make me a hypocrite. Is that clear?"

Captain Tsao bowed her head. "Painfully so, Miss Caltefores. Our facilities will allow us to shut down the shuttle's onboard control and turn guidance over to site operations."

"Then do so immediately."

The older woman touched her brow in salute. "Yes ma'am. It will be done." Her image blanked.

Serena's head slumped back and she let out a weary sigh. "That woman has tried to treat me like a child for years now."

Joe found it surprisingly easy to smile. "Lady, I don't think that's going to happen any more."

"Probably not. At least I was able to keep from breaking the treaty any more than I already have."

A chill went down Joe's spine as he realized that she hadn't heard Bull's offer to let the shuttle land after all. She hadn't been making an end run around Tsao's willingness to let Frank rescue her. She had stood on principle alone. *That* was the act of a warrior.

Jubal let out a whoop. "The shuttle's lifting. Onboard control is shut down and she's mine now. What should I do with her?"

Joe scrubbed his forehead wearily. "Bring it back here, I guess. Can you put Frank under arrest?"

The factor's face split in a lopsided grin. "We can give it one hell of a try."

"Go for it." He turned to face Serena's image once more. "Well, I guess we won. The problem is, you're no closer to being rescued than you were when you crashed."

She chuckled, then grimaced. "Maybe that's why I don't feel like a successful executive."

Bull touched Joe's shoulder. "Mister Joe," he said quietly.

LICENSED TO UNZ.ORG
ELECTRONIC REPRODUCTION PROHIBITED

Yeah?"

"Will you help us?"

He stared up at the big alien. "Help you what?"

"Rescue Miss Serena, of course. Regrettably we do not know enough of your physiology or medicine to render much assistance on that count, but you could treat her injuries if you would let us take you to her."

Joe felt a bubble of excitement rise. "Jubal!" he called, his mind suddenly racing. "Call Petra and Hakim. Tell both of them to gear up for a long hard hike. Have Hakim bring a full trauma kit, and tell Petra we'll need a stretcher. We should both go, too. Maybe you'd better call the ship, have them take over the shuttle and take Frank off our hands. Tell the others we'll get back, uh, probably sometime late tonight. Lights! We'll—"

"Mister Joe," Bull interrupted patiently.

"What?"

"You have misunderstood me. I said we would take you there. Already more of us are gathered outside waiting to convey you to Miss Serena."

Joe still didn't get it. "Convey?" he echoed blankly.

"If you have no objections. We can move much faster than you can, the weight of a human will not appreciably slow us down, and we do not find the heavy growth of our jungles much of an impediment. If we depart immediately we can be there in less than one of your hours."

Joe finally understood that they were offering to act as living transport. "You'd do that for us?"

Bull inclined his head. "We would consider it an honor to aid our friends this way."

He glanced at Jubal. "You game?"

"Count me in. I've already called the ship. Let me signal Petra and Hakim. They shouldn't take more than a minute or two to get ready."

Joe turned back toward the commboard. "Did you hear that? The cavalry is on its way."

"Hurry," she said, closing her eyes and letting her head sag back.

On a sunny afternoon 161 days later, Joe was in his office killing time by playing rummy with Bull. The big alien was whipping his butt badly. Guys had nearly eidetic memories, which made them formidable opponents at cards. Joe could have evened the odds a bit by cheating—he could see the reflection of Bull's cards in his glasses—but his mind wasn't really on the game.

His comm chimed. His stomach flipped over. "Yes?" he called.

"She's here—" Mabel began excitedly before remembering herself. "Uh, Madame Caltefores is here to see you."

He took a deep breath. "Send her in, please."

"Should I leave, Mister Joe?" Bull asked, picking four cards off the pile and considering them. "I know that humans need privacy for some forms of communing." He carefully laid down the ace through four of clubs, three fives, the ten through king of hearts and discarded the queen of diamonds, getting rid of all of his cards. "I seem to have won again anyway."

LICENSED TO UNZ.ORG
ELECTRONIC REPRODUCTION PROHIBITED

Joe shook his head as he stood up. "That's OK, I'm sure she wants to see you too." He raised a warning finger. "But I'm not going to let her play cards with you."

His office door opened, and Serena Caltefores walked back into his life again. Just like the first time he'd met her, all he could do was stand there and stare.

The last time he'd seen her had been as she was being loaded on a shuttle to be taken up to the orbiting supply ship. She'd been unconscious and hooked up to seemingly every medical device at Hakim's disposal, alive but in critical condition.

Bull and three other Guys had gathered up the four people who were going to the crash site in their arms and made tracks in an uncharacteristic haste, a phalanx of five more Guys leading the way to break a trail. Joe and the others had found themselves taking the ride of their lives. The aliens had thundered through the dense jungle growth at speeds occasionally topping seventy kph, hurdling some obstacles with tremendous eight meter leaps and crashing through others like meat tanks in overdrive, covering the distance in just over half an hour.

Serena had been in even worse shape than they had thought—and than she had let on. Not only had both her legs been broken and one lung punctured by three splintered ribs, she also had a broken wrist, various internal injuries, and a broken back. Hakim and Petra had gotten her stabilized, Jubal cocooned her in transfoam to immobilize her body, then the Guys had peeled the wreckage away from her with a breathtaking display of brute strength tempered by tender, almost reverential delicacy.

Guys lived longer than their imar hosts, and two or three times during their lifetime they would abandon the imar body they resided in for a younger, healthier one. Bull and the others were aware that humans were peculiarly body-bound, but it was only upon seeing the shape Serena was in that they truly understood that she would die if her body did. They were aghast at the thought.

After a brief communing with the others, Bull insisted that a shuttle be sent directly to the crash site for her. Captain Tsao already had a second smaller shuttle carrying the ship's doctor en route to the BCT worksite and it was quickly diverted to the scene of the crash. They loaded Serena in and watched it lift, Tsao herself controlling its ascent. The supply ship broke orbit and raced toward a safe transit distance only minutes after the shuttle docked.

There had been no word since, not until that morning, when Captain Tsao had sent a message that the *Tahiti* was back insystem and Miss Caltefores would be coming down by shuttle sometime that afternoon. Jubal, who had been running things in Testa's absence, had come to personally give Joe the good news that she had survived and returned.

Serena paused just inside the doorway. She met Joe's gaze and smiled. "Not what you were expecting?"

It took Joe several seconds to find

LICENSED TO UNZ.ORG
ELECTRONIC REPRODUCTION PROHIBITED

his voice. "You look good," he managed at last. "Like it never happened."

"Believe me," she said with a laugh, "it did. I ran up a medical bill big enough to build an entire hospital. Even my father was impressed."

"But you're OK now."

"I'm just fine, and as you can see I'm no more delicate than before." She sketched a bow in Bull's direction. "It is an honor to see you again, Bull. I can't thank you enough for all your help."

Bull removed his glasses and bared his teeth in the Guy version of a smile. "We could do no less for someone who so honored us, Miss Serena. I am delighted that you have returned, and overjoyed to see you so well recovered. Mister Joe said I should stay to greet you, but does not think I should be allowed to play cards with you."

Joe chuckled. "Not for money, anyway. We wouldn't want the Guys to end up owning BCT."

Serena sauntered toward him. Her walk looked fine. In fact it looked great. He knew he was staring, but couldn't stop.

"They already do own a small piece of it," she said. "Father put a thousand shares in a managed account under their name to compensate them for their help. Then they picked up another couple thousand, ones that used to belong to Frank and the faction at BCT which paid him to arrange my accident. Believe me, there was blood in the halls back at BCT for a while."

Joe assumed that was just a figure of speech. Then again, when someone with her father's wealth and power went on the warpath his enemies were most certainly dead meat. He couldn't keep from wondering what might have happened to him if she had died. That wasn't something he wanted to think about.

"So, you're telling me the Guys are rich?"

"Wealthy, anyway." She snickered. "Can't you just see them taking the *tsassa-mahra* baths at Sardonyx?"

Joe said nothing. He had no idea what she was talking about, and this reminder of the gulf of class and lifestyle between them made him feel obscurely sad.

"Anyway," she continued, "You ought to know that you're talking to the new Vice President in charge of Site Operations."

The gulf just got wider. "Congratulations."

"Thanks. I've already started making some changes, and have plenty more planned."

Joe smiled. "I just bet you have."

"One I'd like to make is hiring you away from the BAA. I'm offering an upper echelon job with an embarrassingly high salary."

Joe's smile faded. He'd had a feeling that, being who and what she was, such an offer was bound to come. He didn't doubt that it was genuinely meant as a reward, but how it was meant, and what it would amount to, were two entirely different things.

He turned away to gaze at Bull. The answer he would have to give her was largely based on the way his relationship with this oversized, occasionally aggravating person and his kind had changed. Serena's crash had marked a

LICENSED TO UNZ.ORG
ELECTRONIC REPRODUCTION PROHIBITED

turning point, maybe even a coming of age for him. Bull and the other Guys were no longer just his charges, or his responsibility, but his friends. The protection of their interests demanded the very best he had to give them.

He returned his attention to this woman who, in her way, was as alien to him as any Guy. "Thanks, but I don't think so."

She crossed her arms, her face unreadable. "Why not?"

"I know you have good intentions, and I'm honored by your offer, but the advocate for an alien people can't function properly if he's in someone's pocket. Even someone as nice and well-intentioned as you. I know my place. It's not inside BCT."

She seemed to be taking his refusal well; in fact she appeared to be trying to hide a smile as she said, "OK, I guess I can accept that."

He peered at her uncertainly. "You seem almost happy I said no."

"Do I?" She shrugged. "You would have been extra overhead, and you know how important BCT's profits are. Besides, I also happen to have a second job offer for you. You see, while I was still in the hospital I started negotiating with the BAA. It took all the clout I had, and I admit that I traded on looking like the daughter of Frankenstein to get my father's help, but I got the BAA to create a new division. It's called 'Standards and Practices Oversight for Treaty Enforcement and Fair and Ethical Treatment of Native Races.' I admit that's quite a mouthful, but I think it's something that's been needed for quite a while. The job of being Field Director in charge of keeping an eye on BCT's performance in those areas is yours if you want it."

Joe stared. "Me?" There was that gulf again. She'd spent the past months bending vast bureaucracies to her will. He'd taught Bull how to beat him at rummy. With Jubal in charge and the treaty being scrupulously observed there hadn't been much else for him to do.

She came and parked one round hip on the corner of his desk. He realized that she was wearing perfume. For him?

"Now before you answer, let me warn you that the job has some drawbacks. It will mean a lot of travel, going from planet to planet and site to site, checking to make sure the BAA agents under your jurisdiction aren't cutting corners or getting too cozy with BCT site management. You'll probably have to spend months at a time dealing with this spoiled rich bitch my father put in charge of site operations, and although the pay is a bit better than what you're getting now, it may not be enough to compensate for that."

Joe just sat there staring at her. She stared back. Both remained poker-faced.

The silence spun out until Bull spoke up. "I believe that this is as much an offer of mating as it is of new employment, Mister Joe."

"I believe you're right, old friend," he answered, his gaze still locked with hers.

"So what do you think?" she asked softly, the faintest hint of vulnerability creeping into her voice.

He cleared his throat. "What you're proposing sounds like a dangerously

LICENSED TO UNZ.ORG
ELECTRONIC REPRODUCTION PROHIBITED

cozy relationship between the BAA and BCT."

I know. But cozy isn't *always* bad. It might even be kind of nice."

It might at that," he said, feeling a rush of heat. He wanted to say yes. She wanted him to say yes. But if he just gave in, would she respect him in the morning? He tried to adopt a severe tone. "I'm sure you're aware that there would have to be very strict ground rules for something like this to work."

She arched one dark eyebrow. "Like a treaty, you mean?"

He nodded. "Something like that."

"You are both exceptionally good at maintaining a treaty," Bull offered. "This I know to be quite true."

"Listen to him," Serena said in a soft, hopeful voice. "He's very wise."

Joe shot the big alien a look, then snorted. "He's a wiseGuy, that's what he is."

His inadvertent bad joke broke them both up. Laughing made it impossible to maintain the solemn faces they were hiding behind.

"I do not believe I understand what is so humorous," Bull said, sounding amused anyway.

Joe came around from behind his desk. "Come on, let's all go finish that tour Frank screwed up, and we'll explain it to you." He offered Serena his hand.

She took it.

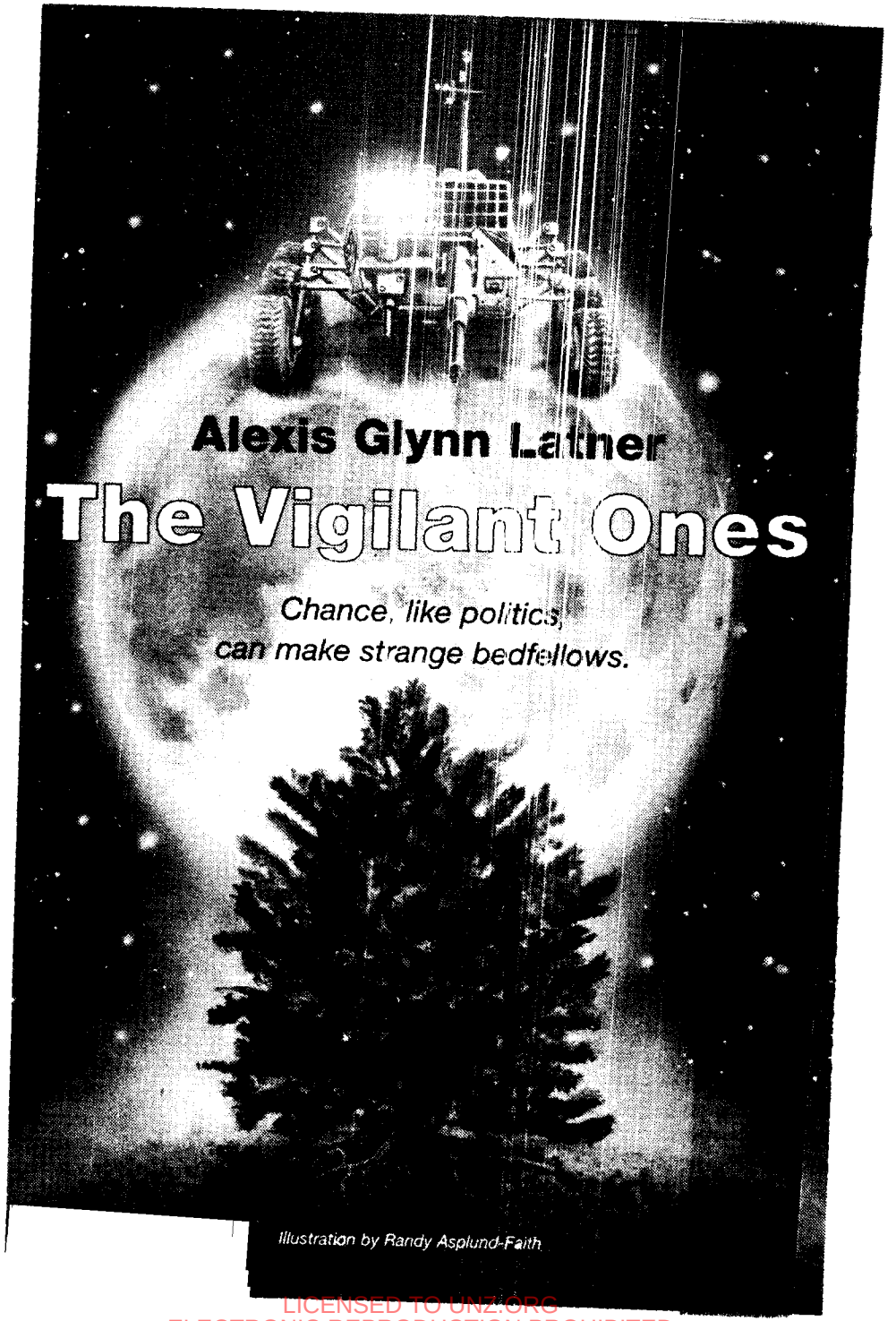
He hadn't agreed to her proposal yet, but they both knew he would. So with that gesture began the first stages of negotiating a pact that would remain sacred and unbroken for decades. ■

MOVING?

If you want your subscription to ANALOG to keep up with you, send both your old address and your new one (and the zip codes for both, please!) to our subscription department;

P.O. Box 54625
Boulder, CO 80322-4625

LICENSED TO UNZ.ORG
ELECTRONIC REPRODUCTION PROHIBITED



LICENSED TO UNZ.ORG
ELECTRONIC REPRODUCTION PROHIBITED

ROBOT SEEKS ICE CUBE ON THE MOON, proclaimed the headline in the local section of the Houston *Chronicle*.

Ice cube?!" Jan Kostryzinski exclaimed, incredulous. What the lunar rover had been designed to retrieve was more like a giant straw full of Moon-dirt Slurpee. Headline writers could never resist an inaccurate but catchy turn of phrase. Jan took a savage bite of her burrito and checked her watch. She'd leave the house by 6:45; her office was only fifteen minutes away. The signal from the Moon would arrive at 7:13 P.M.

Jan's burrito had been in the freezer until she hastily microwaved it. Unpalatable cold spots lurked inside the wrapped tortilla. Twining around Jan's ankles, Nutmeg meowed.

"Cool it, Nutty, you'll get your supper. That's why I came home for mine." Bracing herself in case the contents turned out to be as inaccurate as the headline, Jan read the article.

The *Chron's* science writer had interviewed Jan yesterday in her office at the Planetary Science Institute. Evidently he'd taken good notes. Her name was spelled correctly, with y, i, and i in the right order. The article gave a simplified but adequate background for the project for which Jan was Principal Investigator. It continued, *In the current frugal budgetary climate, NASA deems it more important to send humans to Mars to look for life than to the Moon to look for ice.* Jan mentally added a footnote: "frugal" meant "dirt cheap or no dice on the ice." *The task of sampling ice on the Moon falls to a robotic rover named Cocytus.*

The sidebar sketch made Cocytus look cute, like a bug on six wheels with a bristle extending from its rump. The bristle was its communications antenna. The rover's name came from Dante's *Inferno* where it meant the ninth and coldest circle of hell. That had turned out to be ironically appropriate, because the machine had made life hellish for controllers and scientists as it malfunctioned its way across the lunar surface after exiting the lander. The newspaper article translated the sorry situation into "scientists and engineers have had to overcome a series of mechanical difficulties."

To Jan's dismay, the article left out the best part of the project: how confirming ice on the Moon might catalyze the establishment of a lunar base. Jan deplored the priority given to a manned mission to Mars, which absorbed a vast fraction of space exploration money, leaving lunar concerns to dangle on a brittle shoestring of funding. Finding life on Mars or anywhere else in the Universe was a long shot. The surest and best ambition would be to go *put* life there.

With another meow, Nutmeg leaped into Jan's lap just as her attention was riveted by a headline under the Cocytus article. CLEAR LAKE BURGLARIES TURN VIOLENT.

In the last few months several homes in the Clear Lake area had been thoroughly burglarized—news to Jan; she'd been preoccupied with Cocytus. Yesterday, a homeowner had been shot from behind when he interrupted one such crime, less than three miles from Jan's house. Ruffling Nutmeg's

LICENSED TO UNZ.ORG
ELECTRONIC REPRODUCTION PROHIBITED

thick fur, she scanned the downcolumn details with morbid interest.

The burglars were experts, not the typical young punks. They hadn't given the cops much to work with: no fingerprints, no witnesses, no clues except a tentative connection to a dark van, and no tell-tale mayhem, until now. "*They're getting violent because they've had so much success that now they feel totally in control,*" said a police detective. "*They think they know what to expect, that they can handle anything that interferes with carrying out the crime.*"

Jan hadn't been quoted on the Cocytus project. But the paper had given the cop a five-line direct quote. And the burglary article was twice as long as the coverage of Cocytus, which, when she examined the last paragraph, lacked closure. The editors had cut the article.

Sensationalistic journalism! Jan flung the paper down. It was going to be a stressful night for her, and the *Chronicle* hadn't helped.

Jan snatched half a tin of Tender Veal Bits out of the refrigerator, dumped the cat food into a saucer, put it in the microwave and keyed in eleven seconds. Nutmeg preferred having the chill taken off. Jan stalked to the back door and gave the knob a sharp turn to make sure it was locked.

The door opened. So it had been unlocked all day. She'd absentmindedly left it that way a few times before—she'd thought her neighborhood was safe. Unnerved, Jan stepped out into a mild but breezy early night.

Jan's back yard had a high fence and little for an intruder to hide behind just several thin trees and one large shrub near the patio. The yard was empty and quiet. The shrub rippled in the breeze. Its dense wind-stroked greenery reminded Jan of Nutmeg's ruffled fur—an extraordinary impression that made her take a second look at the shrub.

Jan didn't know what it was, except not a ligustrum. Everybody had ligustrums, and ligustrums had glossy pointed leaves. Short needles cloaked Jan's shrub so thickly that it wasn't possible to see the branches inside of it. Needles probably made it a member of the cedar-pine-whatever family. Jan felt a twig's tip. It had the bristly-soft texture of a test tube brush. The shrub wasn't prickly to brush against, but Nutty, who freely sharpened her claws on all other wood in the house and yard, always avoided the shrub, circling wide around it when slinking along the side of the house.

OK, it's a whatever shrub, Jan thought with a mental shrug. At least it liked it here. It had come up on its own soon after she bought this house, and had grown taller than she in only six years. She fertilized it at erratic intervals. Everything Jan tried harder to cultivate fared much worse. Jan was a soil chemist with a brown thumb. The situation escaped ludicrous irony only because the soils she had chosen to study were the barren grains and dusts on the face of the Moon.

The microwave pinged. Nutmeg instantly let out a shrill feed-me meow. Jan secured the back door, regretting that she'd never gotten around to getting a better dead-bolt lock for it. Leaving Nutmeg purring over her food bowl, Jan started the short drive to work.

LICENSED TO UNZ.ORG
ELECTRONIC REPRODUCTION PROHIBITED

Nervous tension tightened Jan's shoulder muscles and made the burrito sit heavily in her stomach. Tonight was the night for Cocytus to get its sample or die trying. As cranky as the robot had turned out to be, it was doubtful that the mission controllers could keep it going much longer on the frigid floor of Aitken Crater. She was strung-out, Jan admitted to herself, in a state of mind where even ordinary things, such as the shrub in her yard, could strike her with strangeness.

The few stars bright enough to be visible past the street lights twinkled in the night sky, long-traveled light falling through a clear but turbulent layer of air over this part of the Earth. When Jan stopped her car at Bay Area Boulevard to wait for a break in traffic, she noticed clouds massed on the western horizon. Lightning simmered in the clouds. The newspaper had said something about an approaching Pacific cool front that was expected to collide with warm, moist Gulf air tonight. So it had. Tumultuous warfare of weather filled the western end of the sky, just below the crescent Moon.

Storms threatening to engulf the Moon. Primitive people, including Jan's ancestors in central Europe, would have taken it for some kind of bad omen, maybe a sign of impending natural disaster or war, Jan reflected. But the Moon circled two hundred forty thousand miles beyond the vicissitudes of Earth's weather, untouched by weather or war. Or crime. A blue van turned off Bay Area. She noticed how dark it looked in sodium-vapor lighting.

Jan hated having to be worried about crime tonight. There was more than enough to make her worry, happening hundreds of thousands of miles away.

Rooted in a mild and fertile soil on its adopted world, the greenling flourished.

Warm and cold airs collided in the sky above. They wrestled with each other, oozing lightning and thunder. The greenling slept through it all.

Racial memory woven through the greenling's genes made it stay motionless, hiding its active attributes, whenever the human who shared its homeground came near. On the night of the weather's tumult, when the human handled its twig, Memory stilled the greenling's reaction and kept the sensation from intruding on its sleep. Memory deemed the greenling's sleep—or rather, the dreaming that then unfolded—vital to its development, not to be interrupted by anything less than peril.

Like a taproot, the greenling's mind was drawn to what lay below the deep dark ground of sleep, a reservoir of lucid dreaming. It dreamed about a once and future war across half a galaxy of stars.

Peter Reiten, the planetologist from the University of Texas, bounced into Jan's office at the Planetary Science Institute as soon as she had the door open. His shock of dark hair looked even more aroused and uncombable than usual. "Got everybody?"

Jan showed him the screen on her workstation. The blank left half of the screen awaited the reacquired signal

LICENSED TO UNZ.ORG
ELECTRONIC REPRODUCTION PROHIBITED

from Cocytus. The top right quarter of the screen showed the Main Mission Control Center in Baltimore, while Professors Murray Franklin and Mandeep Singh at the University of Arizona gazed expectantly from the bottom right quarter. "All but the bug."

Ed Huang, the Program Manager in Baltimore, settled into his chair. "Hiya, Janko. Ready to roll?"

Situated with stack of papers and disks at his side and his laptop computer open, Peter nodded. Jan gave the little CCD camera on top of her workstation a firm, level gaze. "Ready at PSI."

Peter asked in a whisper, "Why did he call you 'Janko'?"

"It's a short cut around a long last name."

"Cool."

In a tiny window on the blank side of the screen, the clock ticked toward 7:13. Jan's office lacked windows. She thought she heard a dim muttering of thunder from outside of the building. Local weather wouldn't interfere with the signal from Cocytus: relayed through the Deep Space Network, the signal would fly to the Jet Propulsion Laboratory and be distributed to Main Control and the Science Sites via the Internet. Thanks to the uninterruptable power supply—UPS—not even a local power outage would break the skein of communications. Contact with Cocytus depended only on the orbital alignment of Earth and Moon, which cut off the signal some of the time. Reacquisition hadn't failed yet. But it always felt iffy.

7:13:03."Clock accurate?" Peter whispered to Jan.

"I synchronize it with the Naval Observatory when I log on."

Ed said gravely, "Let's hope DSN has a signal to relay."

Murray and Mandeep waited on their corner of the screen with concerned faces.

There'd been difficulty in receiving the transmissions from Sojourner on Mars in 1997, Jan reminded herself. And it hadn't jeopardized that outstandingly successful mission.

Suddenly the picture from Cocytus wavered in. The M & M's grinned and Peter let out a sigh of relief.

The picture wobbled and bounced. That meant Cocytus was in motion, receiving the signal from Control and proceeding deeper into Cold Trap Alpha. Jan let out her own breath.

The bobbing image showed ancient alien terrain, rumpled and deeply shadowed. Jan irrationally expected to see a wide white sheen, a frozen lake, in the distance ahead. That was *not* what they could reasonably expect to find: more like water ice invisibly mixed into dust and grit. Cocytus carried a microsampling instrument and the new Evolved Gas Analyzing Device. The EGAD had not detected water molecules in the tiny samples of lunar soil taken in the traverse so far.

The only good reason to hope for ice was an old radar signal.

Five years ago, the Clementine space probe had found something that reflected radar signals in a way explainable as small ice patches near the south pole of the Moon. Ice might have come from a comet, a cosmic snowball that collided with the Moon, an unknown time ago. The shad-

LICENSED TO UNZ.ORG
ELECTRONIC REPRODUCTION PROHIBITED

owed. frigid environment at the bottom of Aitken Crater might preserve cometary ice in that event. Still, there'd been no incontrovertible proof of it. Confirmation of Clementine's discovery had had to wait. Until Cocytus. Until tonight. Suspense did a tap dance on Jan's nerves.

The picture humped up toward the black lunar sky and stars. The picture dropped back toward the Moon surface and a pool of shadow blacker than before.

Mandeep said, "We need the light."

"Remember, it drains the batteries," said Ed Huang.

But tends to keep the bug's instruments warm," said Jan. "And that shadow has to be cold as sin."

Three seconds later, the time it took for a command to reach the Moon, Cocytus's headlight laid a bright patch of illumination on the terrain, changing inky shadow to ashy dust, grit, and rocks, including, at the edge of the patch, a lumpy but remarkably round rock.

Something clicked in Jan's mind. "Send it to that round rock," she told Ed. "I bet there's paydirt there."

Cocytus altered its course as directed by Main Control. The calibration scale, yellow lines on the picture, indicated the round rock to be softball-sized. Peter, who'd been clicking away on his laptop, paused. "Unless it's an artifact of the halogen headlight, that's a funny color for Moon rock. It's greenish."

Jan had her own feeling of significance about the rock, even though the soil around it appeared no different from anywhere else in tonight's traverse. "It's shallowly embedded," she said. "We could roll it out of the way and look under it for water."

"That's not in the plan," Ed pointed out. "Can I get a consensus on the suggested activity?"

"I'd like a better looksee," said Peter.

The M & M's conferred with each other, then nodded.

Ed's people had the robot place one wheel against the side of the rock and ambulate forward. The rock rolled away readily in the light gravity. The robot's microsampler needled the surface beneath.

Jan eagerly waited for the robot's EGAD to send her results. When the data came, she grabbed it with her interpretive programs.

"I wish the budget cutters hadn't taken out our rock chipper," said Peter wistfully. "A piece of that rock might have been a consolation prize if there's no water ice."

A few minutes later, Jan slumped in dejection. "No H_20 in this particular ground. Sorry, guys."

"Earlier, when the robot climbed first up then down, it seems that it entered a secondary or tertiary impact crater," said Mandeep, who had evidently been making good use of his own time. "That impact would have volatilized any water there."

"Let's get a move on," said Ed. "It hates stopping in the cold." They'd already had repeated problems with the lubricant in the robot's joints setting up.

The picture didn't waver, wobble, or move.

"Uh-oh," said Peter.

"We've seized up," Ed said, his soft

LICENSED TO UNZ.ORG
ELECTRONIC REPRODUCTION PROHIBITED

voice unchanged even with bad news. "Either from the cold or the motion involved in moving the rock, putting an asymmetrical stress on the drive train. We'll try calisthenics to loosen the lubricant. That worked before. . . ."

The picture soon began jerking back and forth.

"Turn off the light to save the battery," said Murray, his voice harsh with frustration. Three seconds later, the screen went black.

"Now's a good time for a break," Jan told Peter and the M & M's. She stayed calm on the outside. Inside, she asked herself furiously, *Any more bright unscientific ideas???*

The greenling dreamed of a strange familiar planet with a fiercer star, hotter days, and colder nights than Earth. Green People spread across the world like a blanket, joining roots and branches to lift up living, leafy substance in dense canopies and glorious vaults. Small, soft, mobile creatures took shelter in the safe green spaces.

Into the greenling's lucid dream, the racial memory encoded in its genes inserted a brief bit of education. *Symbiosis is when dissimilar creatures live together for mutual benefit. They help each other.*

The greenling heeded impatiently. It knew about symbiosis, and evolution, and many other things that Memory had explained before, both when the greenling was awake and when it dreamed. Memory was something the greenling took for granted. The greenling was eager for the next and more exciting part of the dream. Its whole life long, whenever it dreamed, it always had the same dream until the very end, when the dream always unfolded a little more than last time.

Green Paradise was imperfect, afflicted by insects: bad creatures with hard skins and sharp mouth parts that bored wood, chewed leaves, and sucked the living sap from People. In the end, the Green People left the plaguesome insects behind in the dust of their first, and outgrown, world. The Green People and their symbiotes leaped from the First World to planets across the stars. The greenling cheered the great triumph of the People even though it anticipated the next turn of the story with delicious dread.

The People met a great and unexpected horror.

Insects from far unknown stars attacked the green worlds of People. These Insects were like and unlike the insect kind on the First World. As large as small People or big symbiotes, the hateful creatures had segmented bodies with hard skins, deadly mouth parts, and cunning minds.

Intelligent insects, interjected Memory. The greenling's genes were designed to unfold new traits in the natural progression of its physical maturity. Its racial memory unfolded in a coordinated manner, attuned to the greenling's maturing ability to comprehend. *They had starflight too. They weren't content with the worlds they already infested. Insects are always eager to make new infestations.*

The greenling unquestioningly agreed.

Ever since Paradise, the Symbiotes had made tools and machines for the

LICENSED TO UNZ.ORG
ELECTRONIC REPRODUCTION PROHIBITED

Green People. The insect-Enemy made tools with which to attack People. On world after world, the insect-Enemy ravaged the living-grounds of the Green People.

The symbiotes made special new tools—

Weapons—

—With which to fight back. Attack and counterattack, defeat and victory seesawed across worlds and stars.

War

The greenling knew that this dream was not a made-up fantasy, having been instructed by Memory that the dream was real history. But the greenling did not understand what "real" meant. It only knew a small, safe, familiar universe of which it was the contented center. It experienced sunlight and rain and home-ground shared with friendly mobile things. Those constituted its reality. The dream seemed like a story, and a very entertaining one at that.

The greenling expected, but still found deliciously chilling, the dreamed image of a deserted town, the bleached vegetable corpses of People heaped on the graveyard, too many dead to decently compost. The Symbiotes were all gone, having fled for their lives. The home-structures they abandoned were broken into by Insects wanting living sap and blood to suck.

In time, the Green People devised new weapons of their own to defend themselves. Not like the machines of the symbiotes and insect-Enemy. Green weapons.

As the part of the story that the greenling knew drew to an end, it shivered with anticipation that the story would go on and dread that it would not. What could possibly happen next? The Green People had to win the war—didn't they?

In the break room down the hall from her office, Jan poured a cup of coffee for Peter. The pot was fresh and full now. It wouldn't be by 3 in the morning, when the changing alignment of Earth and Moon closed the communications window for this crucial traverse. "I think I know why I fixated on that stupid rock," Jan told Peter ruefully. "It reminds me of some geodes my ex-husband brought back from a diving trip to Canada. He found them in a crater lake."

"Crater lake?"

"Yeah. So I guess the rock on the Moon reminded me of water, so I went for it. Mistake."

Intuition usually served Jan well. But it could give false positives. She expected her confession to elicit more or less polite disapproval, but Peter murmured, "Very interesting. What hap—"

At that point, Charlie Tangley, the network computer technician, invaded the break room. "I detect coffee!" Charlie proceeded to empty a large fraction of the pot into a big commuter cup with bright Astroworld cartoons on it.

"What happened to the geodes?" Peter asked Jan.

"Well, I kept them around for a while for sentimental reasons, then—"

Charlie interrupted. "Sentimental? You?"

Taken aback, Jan wondered what

LICENSED TO UNZ.ORG
ELECTRONIC REPRODUCTION PROHIBITED

Charlie meant. She knew that she could come off as brusque and cynical at times. In the years since her relationship with Mike died, had she developed a rough shell—like a geode—herself? "Anyway, after I bought a house, I tossed the geodes into the bluebonnet bed in the backyard."

The erstwhile bluebonnet bed had been located next to the patio outside the back door. Jan involuntarily remembered the recent burglaries. She did not want to return to her house in the middle of the night. If Cocytus did its job, though, the science team would have enough data and jubilation to keep going all night, and she would go home in the safe light of day.

"You grow bluebonnets?" Charlie inquired.

"I attempted once. Unfortunately, I've got a brown thumb."

"I hear if you scrape the seeds they'll germinate. There's a technical term for that. Scarification."

"I tried," said Jan. "No dice."

Charlie Tangley was a nice guy, but people called him Charlie Tangent for very good reason. Peter regarded Charlie with the kind of look he might have given a garish invertebrate encountered while collecting rocks in the field.

"Where do we go next?" Jan asked Peter.

Peter had been updating the modeling of Aitken Crater with the data from Cocytus. "The bug's not in the deepest part of the cold trap yet. I'm convinced that it needs to be, if Ed can get it going again."

"I read in *Av Leak*, that is, *Aviation Week*, that Japan's working on a new rover. For Mars," Charlie informed them. "The Japanese thought it would be technically easier than a lunar-polar rover. Moon pole cold is worse than summer on Mars, you know."

Ignoring Charlie, Peter told Jan, "I want to revise the road map. There's a path through the part of the crater where the shadow is deepest, then up a steep wall and back into sunlight in less than an hour."

Jan nodded eagerly. "Great idea. If only Ed can get the bug going again—"

A faint chime reverberated from down the hall. "Your workstation is calling," said Charlie cheerily. "Maybe Ed did."

As Jan hurried down the hall with Peter, he asked, "What was inside those geodes?"

Jan felt momentary embarrassment. Mike had been a limnologist, diving to study populations of fish. He'd found the geodes, one broken in half and the other intact, in the debris of an underwater rock slide in the cold blue bottom of the lake. He brought them to Jan as a present because her research had just veered toward space geology. Her background was chemistry, though, and even doing extraterrestrial chemical geology, she'd never been a rock jock. So his geodes had been of only brief interest to her at the time. "Agate, I guess. Green crystalline stuff in spherical layers. If you're interested," Jan went in an afterthought, "I'll dig them out of the flower bed for you."

Peter flicked her an appreciative look. Jan noticed that he had large, expressive brown eyes with long lashes,

LICENSED TO UNZ.ORG
ELECTRONIC REPRODUCTION PROHIBITED

and a good physique. That was the moment—unexpected timing, on a difficult night with the Cocytus mission hanging by a thread—when Jan realized that she had gotten over Mike, once and for all. Getting a better job, buying a house, even sorting through and putting away things that reminded her of Mike, hadn't made that happen. Time had. It had been six years since she wistfully placed Mike's old geodes on the ground among bluebonnets that never grew.

To the greenling's delight, its dream did continue. Among the Green People and among the symbiotes too, there were individuals with special intelligence, skill and understanding of how the Universe worked—*scientists*. The greenling saw Green scientists and symbiote scientists join in hope and desperation on a project, the aim of which was to save the future.

They took the essence of living substance—*genes*—from Green People, plus some from symbiotes, and crafted the genes into new kinds of potential Green People carefully written in artificial seeds. Then they cast the seeds out into the universe.

The scientists realized that hardly one out of thousands of seeds would land in a suitable place. But the seeds were durable to the point of immortality until the moment of germination, and in order to germinate, their needs were few: solar radiation, traces of water, and granular rock—sand, dust or soil—in which to take root. Whether a seed germinated in the time it took for a world to go around its sun, or the time it took for a sun to go around its galaxy, did not matter. Memory said: *It took a thousand generations and grief untold for Green People to learn how to defeat Insect Enemies. The memory of how that was done must last forever.*

Watchfulness must endure. Forever. Because some of the hive-ships of the Enemy flew away from the fields of war—like winged bark-borers flying away from sterilizing fire, seeking fresh treeskin to infest.

Arbor-ships can't outrace hive-ships. But Green Seeds can.

That wasn't the kind of interesting information that Memory usually dispensed to its avid student. This time, Memory meant something different and somehow ominous.

The greenling abruptly awoke from its dream with rain tapping on its outer surfaces. Despite the pleasant sensation, the greenling found itself uncomfortable on the inside. Always before, the entertaining dream had left the greenling feeling pleased. This time, the last part of the dream felt hard and unfriendly to the greenling, like a rock that the roots of its soul had to grow around.

Even worse, the greenling immediately discovered something strange in its own self.

For a couple of years, a cluster of growths had swelled on the greenling's central stem, gradually becoming a familiar part of its intimate world. But now the cluster felt large, odd and awkward, as though something needed to be done with it.

The hard dream had somehow touched the greenling's inmost parts and *changed* the greenling. Such an

LICENSED TO UNZ.ORG
ELECTRONIC REPRODUCTION PROHIBITED

unsettling thing had never happened to it before.

Tinythings scurried on the ground beside the base of the home-structure. These were the largest sort of tinythings in the greenling's home-ground, with long active legs and busy feelers. The greenling abruptly flicked a sticky string out, snared a tinything, and ate it.

The greenling could survive on light, grains of rock, and water, but it had the means to supplement its diet with lesser organisms which its metabolism efficiently reduced to their component minerals. The enhanced diet made the greenling grow bigger and stronger with rapidity. Also, it liked the crunchiness of the tinythings as it incorporated them. Tonight, though, the greenling wasn't really in the mood for snacking. It watched the other tinythings intently, registering them as tiny blurs of heat and weak electromagnetic field, wondering why they held more than the usual temporary interest for it.

Then Memory spoke in its intangible whisper. *Those are insects.*

Sudden understanding shocked the greenling. Of course! The tinythings had hard, crunchy skins. They chewed and sucked juices from the mindless plants in the home-ground. Insects! *Enemy?*—the greenling wondered wildly.

Memory said, *Those are mere insects like the pests on the First World. Insects but not Enemy. Not yet. Not unless evolution makes them much bigger and more dangerous and intelligent.*

A gout of torrential rain descended on the greenling, liquidly pummeling its branches like the realization that beat on its soul. It had always been told that its dream was real. Now it understood what *real* meant. Dead People, vegetable corpses piled high, desiccated forests and burnt green worlds, everything that the dream had shown the greenling, unfolding over its whole young life, the whole story that it enjoyed so much, had really happened, just like the rain was happening.

Sapthirsty, murdering Insects really existed. And *real* meant *they could hurt the greenling too.*

With unaccustomed fear, the greenling urgently scanned its familiar surroundings.

The structure that the greenling grew beside housed a hospitable thing. She let the greenling live beside her own home-structure, which shaded the greenling from the sun and sheltered it from the wind. Sometimes the hospitable thing poured mineral-rich water on the ground near the greenling's roots, which the greenling liked very much, finding it a tasty treat. The hospitable thing lacked a carapace, and she was warm-blooded and soft-skinned, and so could not be an insect. In the same structure there lived a small warm thing which seemed to be a symbiote of the large thing.

At that very moment, the small symbiote was sitting just inside a glass window of the home structure, motionless, perceiving the greenling through the glass. It did that every day.

No Intelligent Insects infested the home-structure.

LICENSED TO UNZ.ORG
ELECTRONIC REPRODUCTION PROHIBITED

The smallest and quickest of warm things lived in the air, sometimes coming to briefly stand on the greenling's branches, which tickled. Memory had long ago informed the greenling that those were birds, and harmless to greenlings. Twelve drowsed in a nearby tree.

Restless and uneasy, not reassured by the normality around it, the greenling opened its senses to receive the whole scope of radiation that bathed its world. Most of the radiation was meaningful—clots of it meant birds and other things, and stipples in the sky were stars. More of the radiation was patterned in a certain way that meant machines.

The Insect-Enemy had created terrible war machines. But symbiotes built machines too, for good and useful purposes. Patterned vibrations in the air and ground told the greenling that big machines moved on the ground and high up in the atmosphere, in exactly the way they always had. The familiarity of it all would have lulled the greenling into its usual, comfortable, happy state—except it still felt troubled about how the dream had ended. Or rather, the dream had ended without an ending, and that felt unfair. Or maybe it was even worse, and harder for the greenling to understand, than unfairness.

The greenling brooded. Deep inside, its cluster ached to do something, only the greenling didn't know what.

The cluster had started out as a bundle of stalks like a bird's nest. Now it was a complex array of curved, meshing members. Had the greenling's foliage not been so thick, and had it been possible for the hospitable thing to see the cluster, she would have been struck by the strangeness of it. But she did not know it was there. Her small symbiote did. Two years ago, the small one had mistaken the cluster, which was busy growing, for an invisible and irresistible bird, and leaped at it. The small one never made that mistake again.

The greenling stretched its senses to a refinement it hadn't known it possessed, sensing details of its world that it had never seen before. Before, it had studied the world with childlike curiosity. It felt different now, driven to learn of its surroundings. So the greenling instantly detected two sizable new things climbing over the fence in a corner of the home-ground.

"Hey Janko, you and I are running neck and neck in the Who Screwed Up the Bug Tally," Ed greeted Jan when she got to her workstation. Ed could be lighthearted now, because he'd gotten the bug going again.

The image seemed jerkier than before, with slow progress across regolith rougher than the surface on the first part of the traverse. The patch of light thrown by the bug's headlight wiggled like an amoeba.

"Come on, baby, come on," Mandeep cooed at Cocytus.

Without warning, the ragged regolith gleamed in Cocytus' headlight.

"Look! There!" Jan exclaimed.

"Yes!" Ed said triumphantly.

Shadowed by the impact cone in the center of a deeply shadowed crater, a whitish-gray pocket lay cra-

LICENSED TO UNZ.ORG
ELECTRONIC REPRODUCTION PROHIBITED

dled in the depths of Aitken. It could only be frozen volatiles. Ed directed the bug that way, zigzagging around rocks bigger than itself. Each lurch of the image shot a needle of suspense into Jan; she feared that any zig or zag might be the bug's last movement. It seemed like ages until it reached the white stuff, which looked so much like old and dirtied snow that hope took Jan's breath away. "Sample," Jan whispered. "Quick."

Ed said, "We better grab the core and go. The bug's got terminal arthritis."

"Transition control to me." Seconds later, Jan was operating the bug's core drill from her own workstation keyboard. "The drill's deployed," she reported tensely. Peter leaned over her shoulder. "Contact." She keyed in the force control. "Low force. Resistance." In a window in her workstation, she had EGAD results coming in. *Highly probable H_2O!* They were in the money. She'd trained for this in simulations. Now she knew exactly what to do. Fatigue and worry vanished in a laserlike intensity of concentration. "Make that mid force. We've got penetration of the surface. —*Hey!*" The drill had stopped responding to Jan's commands. "I'm not getting response! Maybe I've got a glitch on my end—Ed??"

Ed, punching his own backup controls, made a choking sound. "The drill arm locked up."

"It's not in deep enough to do any good at all," Jan said in despair. Nothing Jan did could make the drill penetrate the surface any further. She tried toggling it in and out. The result was that when the drill finally froze up unalterably, it was in the half-retracted position, out of the regolith and extending over the bug's head. There might be a trace of ice sticking to the tube; no more of a sample than that.

Mandeep cursed each of the robot's lubricants by trade name. Murray said savagely, "Looks like this'll be an early night after all!"

Peter shook his head so energetically that his shaggy hair flew from side to side. "Not yet. Look where the bug is. Only fifty yards from the crater rim. It's a steep fifty yards. But the rim is in sunlight. A little solar heating might warm the bug up well enough—and long enough—to run back in and get the sample."

"We do it," Jan decided.

The things vaulting over the fence around the greenling's home-ground were somewhat larger than the hospitable thing that lived in the home-structure. But *that* thing was semi-rooted; she always kept at least one appendage on the ground, and had never once proceeded over a fence. Moreover, rain made the hospitable thing flee into the home-structure, whereas these two seemed busy and energetic even though water poured from the sky and pooled on the ground. These had to be a different kind of thing—possibly a kind that needed wet air moisturizing their breathing organs in order to be active.

The greenling suspiciously perceived the two things dash toward the box affixed to the wall of the home-structure. Because the greenling could sense electromagnetic fields

LICENSED TO UNZ.ORG
ELECTRONIC REPRODUCTION PROHIBITED

and radiation: it knew that the box admitted electricity into the structure. The hospitable thing liked living in a bath of electromagnetic field, with electricity streaming through the walls of her home; the greenling thought she might need such surroundings in order to live. All organisms had to have the right *environment*.

The two strange things made themselves briefly active in the proximity of the box. Electricity abruptly ceased flowing into the house-structure.

The greenling stiffened all its needles in alarm. The thing that lived in the structure would not want to have no electricity all around her. The lack might even hurt the hospitable thing.

These new things had to be Enemies. Enemies, right here on the greenling's own home-ground.

It had never met an Enemy before. But its reflexes had been distilled from a millennium of war. With the deep-rooted patience that only a predatory plant can muster, the greenling waited in the hope that the invaders would stray toward it.

To the greenling's bloodless, clear joy, the enemy things approached the wall-opening that greenling stood near. Too slowly to catch a mobile organism's attention, the greenling stretched itself closer, hardly stirring the molecules of the air as it parted them.

The two enemy things touched the wall-opening, which was tightly shut, as always when the hospitable thing wasn't proceeding through the opening. The greenling now understood what the enemies wanted: to break into the home-structure, which was just as bad as their intruding onto the home-ground, because it was all the greenling's very own territory.

The invading things paid the greenling no heed. And no wonder its presence didn't matter to them: they were too far away for it to reach, and too interested in the wall-opening for the greenling to hope that they would blunder into its eager branches. The greenling's frustration made the cluster in its core throb with strange, painful tension.

One of the things extended a long, sharp part. It touched the edge where the wall-opening met solid wall. Knowing that the edge was a relatively weak part of the home-structure, the greenling watched anxiously.

The enemy thing began *boring into the structure*.

Primed by a lifetime of instructive dreaming, the greenling recognized boring. The greenling instantly associated what it was perceiving with one, only one possible, galvanizing reality. *Insects. Plant-borers. Destroyers.*

A new feeling rushed through the greenling as though heated water had entered its roots and instantly traveled to the ends of its twigs. For the first time in its life, the greenling was outraged.

The cluster in its core pulsed with expectancy so intense that it hurt. In the instant before the greenling could not withstand the sensation any longer, it suddenly knew what the cluster existed for.

The greenling did not have to wait at all. The home-boring enemies were close enough already. The greenling had *weapons* of its very own.

* * *

LICENSED TO UNZ.ORG
ELECTRONIC REPRODUCTION PROHIBITED

The cold-racked robot slowly, painfully retreated up the crater wall. They had turned off the headlight to save the battery. The image showed nothing but a black bowl of landscape with bright untwinkling stars above it.

Go up and out: it was simple. It was also incredibly tedious to watch. Jan's neck muscles tied themselves in a painful macrame of tension knots.

"Look at ten o'clock. That's one of your geodes!" Peter hissed. "I'm marking its location. Why are green geodes scattered around in Aitken crater on the Moon, and in some crater lake in Canada?"

Jan shrugged. Fixated on Cocytus, she found it entirely academic that green geodes should occur in craters both on the Moon and in Canada.

Peter muttered something about organizing a diving trip. "What lake was it?"

"Reindeer Lake. Some geodes lying at the very bottom was what Mike said he found. In the dim cold deep," Jan replied, probably sounding as distracted as she felt.

"I can't imagine a meteor impact creating rocks like that." Peter had decided to worry the geode mystery like a dog with a leather bone. "Tektites yes. Geodes no. If they were embedded in a soft meteor that burned up around them—yeah, maybe—but no known meteorites are like that."

"We've got to get the ice," Jan said. "That way, there'll be a base established at Aitken. And then you can have somebody in a space suit hunt rocks for you."

The bug's field of view dipped into a chiaroscuro of black and bright spaces. "Ah," said Mandeep. "We've happened into a very fresh crater here in the lip of Aitken. The far side of it is lit by sunlight."

The camera's field of view was too narrow for Jan to have guessed that much about the bug's whereabouts. Annoyed at how little the picture told her, she abruptly summoned a computer-generated sketch of the rover in relation to the Moonscape, displayed in a window of her workstation.

Peter murmured, "If the bug can climb to the main crater rim, it'll catch some of those rays."

"It's in a very fresh secondary crater," said Mandeep. "And look at the streaking. A good deal of material has been flung about. I'm seeing fractured rocks, too, and other signs of violently ejected debris."

The real-time animation in the window showed Cocytus in sketchy, cartoonlike form. It emerged from the crater with one last exertion of its drive train, scrabbling and flexing in the middle, like a silverfish crawling out a sink drain.

Sunlit Moonscape flooded the image of the lunar highlands ahead of Cocytus. The stars above the plain vanished, eclipsed by reflected sunlight. Jan tried raising the core drill. Reluctant, it went, higher, intercepting more of the steeply slanting solar radiation. The animated picture made it look like a formidable stinger on an outlandish insect.

Peter said, "Let's reorient the bug so it catches even more rays, then—"

Without warning, the image flipped. It rotated through at least a full circle, blurred and indecipherable

LICENSED TO UNZ.ORG
ELECTRONIC REPRODUCTION PROHIBITED

with a brief blaze of sun and a green flash.

"Not like that!" Peter gasped.

"*We didn't do that!*" Ed retorted, his face aghast.

The screen went blank.

"Loss of signal?" Ed sounded incredulous. Behind him, Main Control became a buzzing hive of activity.

Jan felt a sense of composure wrap itself around her. She always reacted to a crisis this way: with detachment and crystal-clear thinking, emotionality reserved for later. "Did we get hit by a meteorite?" she asked Mandeep. "You said we just traversed a fresh impact crater. Are we in a meteorite shower?"

Mandeep paradoxically nodded but said, "No, the new crater's not *that* fresh. It wasn't made minutes ago, or light-weight debris would still be falling out of the sky."

They reviewed the final inexplicable imagery, in slow motion. It told them nothing except that the bug had been spun off its feet and landed on its back. At the end came a weird green blur in the field of view, probably an artifact of a damaged, failing camera.

Peter muttered, "Almost looked like a bush in that last frame. Can't be a bush. But darned it if didn't look like—"

A tap on Jan's part-opened office door interrupted Peter's argument with his common sense. Charlie Tangley peered in. "How's it going?"

"Pretty damn bad," Jan grated.

"Oh. Sorry to bring more bad news, but we're getting a lot of rain, and the news radio says there's street flooding all over the city. If we don't go home soon, we'll be stranded here."

"I'm staying at the Best Western down the street," Peter said impatiently.

Jan said, "We may not be at this much longer anyway."

Charlie helped himself to a spare chair and watched the efforts to contact Cocytus. For once, Charlie found nothing irrelevant to remark upon. He had the decorum of an attendee at a funeral.

Half an hour later, the video link showed Ed sitting with his head in his hands, fingers clutching his hair. "I give up. It's gone. Something nailed us. God threw a rock at us. Something."

Jan felt sick. If it really had been an incoming meteor, it was cosmically unfair, a one-in-trillions mischance. Charlie shook his head mournfully and slipped out.

Having saved the one unexplored hope until it was the last hope of all, Jan reviewed the EGAD data from the last microsample. And there it was. The signature of water, clear as a bell, standing up to cross-analysis. "Guess what, guys, she said shakily. "All was not lost. It did find water. This we can publish."

There was moment of surprised silence from her team. Then Murray said, "Thank God the budget cutters didn't get the EGAD!"

"But I wanted ice stratigraphy," said Mandeep, forlorn. "It would tell us so much about the history of cometary impacts."

Jan still had her emergency calm on. Wearing it like an overcoat to hide her emotionality, she said with even-toned assurance, "I think we'll be back at Aitken Crater before too long, and then we'll send somebody out for a nice long core sample."

LICENSED TO UNZ.ORG
ELECTRONIC REPRODUCTION PROHIBITED

Peter absurdly added, "We'll tell 'em to take hedge clippers too."

An hour later, a few minutes past two A.M., Jan pulled into her driveway, cold, tired, hungry, and wet, especially from the ankles down: the parking lot had been four inches deep in rain water. All the easily-flooded intersections in the area had been inundated, but traffic was nonexistent. She'd been able to take to the middle of the streets and get through.

More than the cold, the memory of the last moments of Cocytus made her shake with turbulent letdown. Time and fatigue had shredded her calm. Fumbling with house keys and key-ring flashlight, she opened the front door and stepped inside before she remembered that she'd left porch and living room lights blazing.

Maybe lightning had knocked her power out.

But Nutmeg normally greeted Jan. Lack of house lights never bothered a cat. More than that was wrong here. Jan's feeling of habit, of returning home as always, did a sickening reorientation, like that last picture from the Moon, hit by the realization that her house might have been broken into. *By somebody who might still be here.*

Fear ran down her spine like ice water. Jan stumbled backward to her door and jerked it open. She stood there, undecided whether to retreat through the cold and wet to her car. She had always thought she'd smell sweat, cigarette, something in the air of the room if a criminal was hiding there.

With a cloud-soft touch of fur, Nutmeg materialized to twine around Jan's legs. Nutmeg took rapid little steps, as if agitated. But she didn't bolt out the door, and wasn't cowering under the bed, either. Considering that Nutty was a total coward, there could not possibly be an intruder in the house.

A scratching sound from the direction of the back door made Jan jump. But the noise came from outside. The back door remained firmly shut. Jan crept to the breakfast nook window and parted the blinds to peer out.

Next to the patio, the nameless shrub flailed in the wind. Jan hadn't realized that the shrub had grown tall enough to scrape the eaves of the house, but it was doing so. The shrub's greenery still looked like cat fur. In point of fact, it looked like an angry, wet cat's fur, standing at attention as the shrub twitched in the rainy wind. The plant looked startlingly alive. "Maybe I overdid the fertilizer last time," Jan muttered.

Released from the trammels of alarm, Jan's tired brain wheeled and careened back to the blurry last image sent from the Moon. The green flash. She belatedly realized that Peter was right, that the last blurry frame had looked—in a vague, Rorschach-blot way—just like a shrub in the bright sun.

Having a wild notion like that in her brain felt uncomfortable to Jan, like water in her ears after swimming. She dismissed it, then checked around the house with a flashlight, found nothing amiss, and went to bed, too tired to worry about the electricity still being off. That was the power company's problem.

LICENSED TO UNZ.ORG
ELECTRONIC REPRODUCTION PROHIBITED

As Jan stretched out under the covers, aching with the overdue pleasure of lying down, she remembered something. Something good.

The EGAD had found water. So manned missions would soon be sent to the south pole of the Moon to build a base, mine the ice and explore the weirdly beautiful terrain. Maybe she ought to update her application to the Astronaut program and maybe, just maybe, someday leave her own boot prints on the icy dust of Aitken Crater.

And find shrubbery on the sunny north rim—?

Jan smiled at the absurdity of the image. No. No plants existed on the Moon. Not yet. With a permanent base—having dome, and air, and warmth and all—somebody'd do some landscaping with grass and bushes under the dome. *Moonscaping*, as Peter Reiten might put it. Jan liked Peter. He made her feel interested and relaxed at the same time. And he was single. . . Jan went to sleep dreaming about the future.

The greenling threshed the rain in excitement and disappointment. It hadn't known how to use the new ability of its cluster. The attempt hadn't gone right.

Tension had turned into a thrilling instant of release as the greenling hurled a bolt from its cluster toward the enemy things. But it was young. Its weaponry was rudimentary, just sharp bolts split off its own substance, hardened and sharpened by the secretive processes of the cluster. The first bolt had flown faster than a bird. But it missed the enemy thing and shattered the corner of a brick on the home-structure wall. The other bolt hit one of the enemy things, but merely knocked off the mouthpart with which it was attacking the home-structure. The things themselves then ran away with very rapid mobility.

The greenling sensed when the hospitable thing came home to the home-structure and did not die or flee from the lack of electricity but rather went to its usual night-rooting place inside the structure. The greenling was relieved. At least that much of the world was right again.

But it had failed to kill enemies invading its own home-ground.

The greenling extended a sticky string to retrieve the mouthpart and brooded over it, manipulating the object with its inner, flexible twigs. The object gravitated into the greenling's cluster.

Not insect part, said Memory of the object clutched and fingered by the cluster. *Just a tool. A drilling tool.*

The greenling was perplexed. Were the things that had invaded the yard not Insects after all? The greenling thought hard. Other than the mouthpart, which turned out to be a tool, they resembled the thing who lived in the house. Maybe they were its own kind.

If so, it had tried to kill beings who were not true enemies. The greenling's branches sagged in consternation. Without meaning to, it must have made a terrible mistake.

Memory rectified the greenling's thoughts. *Mistake, but no wrong. It was good to drive them off. They*

LICENSED TO UNZ.ORG
ELECTRONIC REPRODUCTION PROHIBITED

may be enemies of the thing that lives here. Not every thing is a friend to its own kind.

The greenling struggled to grasp the difficult new concept. It was the opposite of symbiosis, where unrelated things depend on each other. Kindred things might prey on each other? But the reason for kindred was help and strength in numbers, as it had learned from its dream. Feeling small and lonely in a large and complicated universe, the greenling suddenly asked, *Do I have kindred?*

Memory replied. *The seeds of vigilance fly far and wide from the warground, ahead of the infesting hiveships of the Enemy. There must be others in this part of time and space who found home-ground. Others, like you, growing and learning.*

The good world that had received the greenling turned its face to the sun. All that had happened soaked into the greenling's consciousness like water into loam. Gradually the greenling realized that its dream hadn't ended for an important reason. The end of the dream lay in the future.

The greenling's cluster fondled the boring tool dropped by the enemy things. The cluster could alter the tool and use it to make better weapons, if it had the right kind of materials to work with. The industrious cluster made plans.

Sooner or later, the insect-Enemy would come. The greenling and its kindred, equipped with ancient memory and secret arsenals, waited. ■

IN TIMES TO COME

Our lead novelette for May is Stephen Goldin's "The Sword Unswayed." You may remember Deborah Rabinowitz, interstellar detective and part-time Shakespearean, from Goldin's novelette "The Height of Intrigue"; next month she returns with a new mystery to solve, just as offbeat and just as well suited to her unique talents. Amy Bechtel, a favorite *Analog* writer and full-time veterinarian, also returns with a new tale of another veterinarian with a (slightly) more exotic clientele than her own. You may remember some of her patients as "Little Monsters," but next month they have a brand new problem. . . .

Both our serials continue: Joan Slonczewski's novel *The Children Star* and H. G. Stratmann and G. David Nordley's two-part science fact article on medicine in space. This month Stratmann and Nordley concentrated on the problems; next month they'll look at the solutions. And by the merest coincidence, Stratmann also presents a short story called "The Human Touch," about the future of medicine right here on Earth. We can hope he isn't being *too* prophetic, but anybody who's had to deal with a hospital or insurance company lately is in serious danger of more than one hearty, if dark, chuckle of recognition!

LICENSED TO UNZ.ORG
ELECTRONIC REPRODUCTION PROHIBITED

GRAVITY WAVES AND LIGO

Gravity is the weakest force in the universe. Because of this weakness, gravity waves (see my column in the January 1988 issue of *Analog*), the traveling waves made by disturbances in gravity, are below the present threshold of detectability and have never been directly observed. But in the year 2000 this should change.

Curiously, in some ways gravity is also the strongest force in the universe. It always adds, never subtracts, and can build up until it overwhelms all other forces. In normal stars gravity is balanced by heat energy from fusion reactions in the star's core. Eventually, however, the hydrogen and heavier elements fueling these reactions are used up, gravity takes over, and the star collapses in on itself. The result is a supernova explosion, which converts a sizable fraction of the star's mass-energy to light, neutrinos, and gravity waves.

If the original star is similar to our sun, its supernova will leave behind a neutron star, a system in which gravity counterbalances the strong interaction and converts protons to neutrons, so that the entire star becomes one giant nucleus held together by gravity. If the star is about three times more massive than our sun, the gravitational forces will completely overwhelm the strong interaction that keeps the neutrons apart, so that the system will collapse to a black hole.

However, such stellar-scale catastrophes do not occur in isolation. Most star systems are binaries, and when the nuclear fuel of both members of a binary system is used up, the result can be a neutron star binary, a pair of neutron stars orbiting each other.

In 1974 Joseph H. Taylor of Princeton University and his graduate student Russell A. Hulse detected radio waves from a pair of orbiting neutron stars. The timing and Doppler shift of the radio waves from this system allowed them to precisely determine the rotation period (about 8 hours). They made measurements over several years and found that the rotation period was decreasing because the stars were slowly "spinning down," losing a tiny fraction of their rotational energy as they orbited. Taylor and Hulse showed that this loss of energy is precisely the amount predicted by Einstein's general theory of relativity due to the production of gravity waves by the two massive counter-rotating stars. Thus, in a rather indirect way gravity waves were "observed" through their removal of energy and angular momentum from the binary

LICENSED TO UNZ.ORG
ELECTRONIC REPRODUCTION PROHIBITED

neutron star. In 1993 Taylor and Hulse received the Nobel Prize in Physics in recognition of this work.

What are gravity waves? A gravitational field, which can be viewed as a distortion of local space, surrounds every massive object. Gravity waves can be viewed as spreading ripples in this space distortion which arise when a massive object is moved and its gravitational fields disturbed. Like light, gravity waves travel at the speed of light and obey the inverse-square law [intensity is proportional to $1/(\text{distance})^2$]. Gravity waves induce a kind of "kneading" distortion in the space through which they move, making local distances alternately larger and smaller. In one direction perpendicular to the wave's direction of travel space is stretched, while in the other direction space is compressed, with the stretch and compression exchanging places after half a period of the wave. The wave can be visualized as a long sausage with its sides alternately pinched in side-to-side and top-to-bottom, with the pinches along the length of the sausage repeating with each wavelength and the entire sausage moving forward at the speed of light.

Gravity waves have two distinct states of polarization. Viewed head-on, gravity waves with the "+" polarization state alternately compress and expand space top-and-bottom and side-to-side (kneading space with a "+" pattern). Gravity waves having the "X" polarization state compress and expand space along lines 45 degrees to the right of vertical and to the left of vertical (kneading with an "X" pattern). These two polarization states make gravity wave detection more difficult because a given detector is usually sensitive to only one of the two states and therefore detects only half of the possible signals.

One fascinating aspect of the Taylor-Hulse work is its implication that after a few million years binary neutron star systems will lose energy and spin down faster and faster, until finally the stars collide and merge. This spin-down and collision releases a huge quantity of energy, appearing as an intense rising "chirp" of gravity waves. It is expected that other binary systems composed of normal stars, neutron stars, or black holes will also spin down and produce similar cosmic fireworks. These intense bursts of gravity wave energy are expected to occur every few years (or perhaps even every few months) and, given a suitable detector, should be detectable. The ability to detect gravity waves and determine their directions and points of origin would create a whole new science: gravity wave astronomy.

Constructing a suitably sensitive detector, however, is extremely difficult because gravity waves are the wave embodiment of the weakest force of the universe (gravity is 4.3×10^{-40} times weaker than electromagnetism), and the effects of gravity waves on matter are correspondingly small. Early detection attempts using large resonant cylinders as detectors, after some false-positive reports in the 1970's, were shown to be too

LICENSED TO UNZ.ORG
ELECTRONIC REPRODUCTION PROHIBITED

insensitive to detect gravity waves at the intensities expected. At this writing (10/97) gravity waves have never been directly detected. However, this is likely to change soon.

Physicists at the California Institute of Technology (CalTech) and the Massachusetts Institute of Technology (MIT), with $356,000,000 in funding from the National Science Foundation, have joined forces to construct the Large Interferometer Gravitational Observatory or LIGO (pronounced LIE-go). LIGO consists of two widely separated detectors. The original plan was to construct one of these in California near CalTech and the other in Massachusetts near MIT. However, political and geological realities modified this plan, with the result that one detector is presently being constructed at a desert site near Hanford, Washington, and the other in Livingston Parish, Louisiana. Together they form a detection system with its elements separated by about 3000 kilometers (1900 miles), a distance considered optimum for geologic independence and good source position reconstruction. The target date for project completion and first operation is sometime in the year 2000.

The detector at each LIGO site is an L-shaped multi-pass optical interferometer. Light from one or more strong 5 watt stabilized lasers (eventually to be replaced with 100 watt lasers) is split into two beams. These are reflected many times with multiple mirrors and passed many times through two horizontal 1 meter diameter vacuum pipes, each 4.0 kilometers (2.5 miles) long and held at a vacuum of 10^{-9} torr. The two arms are oriented so as to form a giant right angle "L" on the ground. The laser beams emerging after the multiple passes through the two pipes of the interferometer are recombined at a low-noise optical detector, where the light beams interfere so as to reinforce or cancel. The light signal changes with any microscopic change in either path length along the two detector arms. The arms of the detectors at the Washington and Louisiana sites will be pointed in the same two spatial directions, maximizing the probability of coincident detection of gravity waves at the two sites. The "price" of maximizing this sensitivity is that LIGO will have zero sensitivity to one of the two possible polarization states of the signal (the polarization for which the compression-expansion axes are at 45 degrees to the LIGO arms).

LIGO is sensitive to any suitably polarized gravity wave arriving perpendicular to the plane of the detector, providing that the wave has a wavelength of more than about 16 km. This insures that one 4 km arm spans less than 1/4 wavelength of the wave, implicitly requiring a wave frequency of less than about 18 kHz. Such gravity waves cause one arm of the detector to shrink slightly and the other arm to lengthen slightly, but only by about one part in 10^{23} or so. This tiny change in length will shift the phase of the coherent light waves arriving at the detector from the two arms and will shift the detected light intensity, for example, from perfect cancellation to partial reinforcement. At the

LICENSED TO UNZ.ORG
ELECTRONIC REPRODUCTION PROHIBITED

ends of the LIGO arms, mirrors reflecting the laser beams are mounted on "test masses" carefully suspended within vibration-suppressing feedback systems, but there are limits to the effectiveness of such systems in permitting the observation of a signal over vibration background. If the signal frequency from gravity waves is too low, it cannot be detected because it is washed out by system noise due to background vibrations.

LIGO is sensitive to gravity waves only in the frequency range from about 5 Hz to about 20,000 Hz. Fortunately, this range includes the gravity wave frequencies expected from type II supernovas and from the merger of a pair of neutron stars. LIGO has essentially no sensitivity in the frequency range 10^{-4} Hz to 1 Hz, where strong signals are expected from black hole formation or from the merger of a black hole binary system.

LIGO is not the only planned gravity wave detector, but it is the one which is likely to first detect gravity waves. There are several other ground-based projects: the Japanese TAMA project now being tested in a 300 meter prototype in Tokyo, the 600 meter GEO prototype now under construction near Hamburg, Germany, and the 3 kilometer French-Italian VIRGO project being constructed near Pisa, Italy. Some of these projects have target gravity-wave sensitivities similar to that of LIGO and all will have some operational capabilities in 2000. These should not be considered competitors of LIGO, however, but rather additional components of a greater overall system. Together the separated detectors will form vertices of an Earth-size polyhedron detector system that will permit more precise determination of the locations of gravity wave sources and will give improved polarization sensitivity.

All of these earth-bound detectors, however, are expected to "hit the wall" at frequencies below about 1 Hz because of background vibrations of the planet's surface due to human and seismic activity. Only space-mounted gravity wave detectors can overcome this low frequency limit. Fortunately one of the long term projects of the European Space Agency is LISA, a great triangle of interferometer satellites placed well away from the Earth, in their own stabilized orbits around the Sun. LISA, scheduled for around 2020, will be sensitive to the lower frequency 10^{-4} Hz to 1 Hz gravity waves from events involving black holes.

What will be discovered with this new array of gravity wave detectors coming on-line in the 21st century? That, of course, is impossible to say, but we can speculate. Like the new large neutrino detectors SNO (Canada) and Super-Kamiokande (Japan), LIGO should have sensitivity to supernova explosions in our galaxy, even when these cannot be observed optically. Correlating signals from LIGO with neutrino detectors should tell us more about the supernova process. Similarly, we expect fireworks in the optical, gamma ray, and perhaps neutrino domains when binary neutron stars merge. It will be very interesting to see if the unambiguous signal of neutron star merger

LICENSED TO UNZ.ORG
ELECTRONIC REPRODUCTION PROHIBITED

detected by LIGO can be correlated with observations from other detectors. We will also learn if gravity waves accompany the mysterious gamma ray bursts, a cosmic phenomenon that still has no good explanation. (See my column in the October 1995 issue of *Analog*.) And of course, events near the center of our galaxy remain a deep mystery, recently heightened by the observation of a giant fountain of antimatter positrons there. Such cataclysmic events may produce gravity waves, providing new information and insights.

But the main value of the project is that LIGO will allow us to look where none have looked before, giving good odds that we may see what none have seen before, and perhaps what no one even suspects. So be on the lookout for the new developments in gravity wave astrophysics in 2000 and beyond.

AV Columns On-line: Electronic reprints of 86 or so past "The Alternate View" columns by John G. Cramer from *Analog* are available on-line on WorldWideWeb at the URL: http://www.npl.washington.edu/av. ■

References:

J. S. Higginbotham, "LIGO installation opens window to the universe," R&D Magazine, v39, #9, 15-16 (Aug. 1997).

K. S. Thorne, "LIGO, VIRGO, and the international network of laser-interferometer gravitational-wave detectors," in Quantum Physics, Chaos Theory, and Cosmology, Eds. M. Namiki, I. Ohba, K.I. Maeda, Y. Aizawa and M. Namiki, pp. 101-120, AIP Press (1996).

CUSTOMER SERVICE OR SUBSCRIBER ASSISTANCE

Please direct all changes of address and subscription questions to:

ANALOG SCIENCE FICTION AND FACT
P.O. BOX 54625
BOULDER, CO 80322-4625

LICENSED TO UNZ.ORG
ELECTRONIC REPRODUCTION PROHIBITED

David Alexander

SHRINK WRAPPED

Coming soon to a store near you—
but use it with care!

People are the most foolish things there are, sillier than dogs chasing a motorcycle or kittens entertaining a mouse. Shortsighted, credulous, gullible—when it comes to the human race I could go on and on. Take their understanding of "modern" technology, inventions, scientific wonders, for example. We put a few thousand condos on the Moon and people get excited. Well, really, houses with indoor plumbing are nothing new. Yes, they're on the Moon, but so what? Rockets have been around for well over a thousand years, the ones that take people to and from the Moon are just more refined versions. What's the big deal? Sure, we've got computers in our wallets, video phones on our key chains, we make instant purchases with the press of a thumbprint against the face of a watch, but none of that is really earth-shattering, just an incremental improvement of technology that's been around for decades. Yet the average citizen thinks it's all so "modern." It makes me want to laugh. Then, when a really big breakthrough does come along, *a quantum leap in technology*, it's ignored, feared, then driven from the market by a few small minds. How can I say that? From my own tragic personal experience. Who am I?

My name is David G. Wilaru, wordsmith. I carry a pen. Until a few weeks ago I was the Director of Marketing & Communications for Xcitement, Inc., the developer of the most revolutionary invention of the century.

What is this miracle product, you ask? The goal of Xcitement, Inc. was nothing less than to bring the benefits

LICENSED TO UNZ.ORG
ELECTRONIC REPRODUCTION PROHIBITED

of Mental Health to every American with a few spare dollars in his pocket and a copy of The Sharper Image catalog in his mailbox.

If we look at the history of psychiatry we see that the profession has been a miserable failure. It's like a fancy French meal: only a few people can make one; it takes forever, costs a fortune, usually isn't completely successful, and in a few hours you need to do it all over again. Where is the counterpart to the TV dinner for the world of psychotherapy? It has never existed, until now.

My boss, Mr. Slumber, wanted to call our first entry in this untapped market the "Brain Box." Of course, I immediately talked him out of it. Would you want to put your head in a brain box? Of course not! It all sounds so "electrical." I suggested that we name our product the "Confidential Advisor." Like your best friend or your hairdresser or your racquetball coach.

"We'll give it a try, Wilaru," Mr. Slumber agreed reluctantly, "but don't you think it should have more of a high-tech name? Something with a lot of 'x'es in it?"

"How much are you going to charge for it?"

"The base model will be $495.00. Of course, we'll have a full line. The top end will only be available at selected shops on Rodeo Drive. It will have simulated platinum coated contacts and come with a Gucci carrying case for $9995.00. But what does that have to do with it?"

"Mr. Slumber," I began as tactfully as possible, "it is a well known principal of marketing that the price of a product and its name are inexorably linked. You could no more sell a cheap model with a classy name than you could sell a high end product with an ordinary name."

"Why do you say that?"

Poor man, he had no marketing skills whatsoever. I tried to explain as diplomatically as possible.

"It's a matter of trust, you see."

"Trust?"

"Well, perhaps *dis*trust would be more accurate. If someone offered to sell you a new Mercedes for $15,000, what would you think?"

"I'd think that it was stolen."

"Yes, but what if the Mercedes Benz company offered a Mercedes model for only $15,000. Then what would you think?"

Slumber paused a moment then replied. "Probably that it was some stripped-down car made in China that they only put the Mercedes logo on."

"Exactly! You can't call the cheap version of something the 'Imperial Mark IV' and have it succeed any more than you can call the expensive model the 'Classic' and expect hot sales. Our base product will be called the 'Confidential Advisor Classic' and the Beverly Hills model the 'Imperial Power Advisor.'"

"You may have something there, Wilaru," Mr. Slumber said after a few seconds contemplation. "When can you get started on the user's manual?"

"I'll need one of the units for testing purposes. It should only take a week or two to rough something out."

"OK, go down and see Fleem in the lab."

"Fleem in the lab?"

LICENSED TO UNZ.ORG
ELECTRONIC REPRODUCTION PROHIBITED

"Bart Fleem, our chief engineer. Tell him to give you a loaner."

So I went to the lab. It looked like most labs I had seen—machines, wires, knobs, gauges, lights, cables. The employees looked pretty normal too—Grateful Dead T-shirts with pocket protectors, beards, Thom McAn shoes with white socks. I found Bart Fleem perched on a stool in the corner.

He was playing a computer game on the $19,000 engineering workstation. I think it was a variation of the classic "Dracula Bats of Doom." The object of the game was for Squeaky to find the entry code for the phase converter which would allow the dilithium crystals to be recharged before Scotty was vaporized by the Klingons, or something like that. Except that this version was a little bit different; all the characters were nude. Was that Lt. Uhura chained to the communications console?

"Uh, excuse me, Dr. Fleem," I asked hesitantly.

"Wait, I've got to get past those Aldeboran Shellmouths. Wait, wait, yes!" Fleem shouted triumphantly as Squeaky negotiated the last of the obstacles between himself and the Amazon Princess who guarded the bin containing the quadrotriticale.

"It's Mister."

"Wilaru, David Wilaru."

"No, I mean it's Mister Fleem, not Doctor Fleem."

"Terribly sorry, Mr. Fleem."

"Not your problem. What can I do for you?"

"Mr. Slumber said you would let me have a loaner."

"Brain Box?"

"Actually, we're renaming it 'The Confidential Advisor.' Do you have one you can give me?"

Fleem stared at me for a moment, then nodded his head a fraction of an inch. "One Brain Box coming up." I decided that it would be impolite to correct him and just smiled tolerantly. Fleem disappeared through the door to the parts room then reappeared a moment later. Cradled gently in his hands was a box about the size of a small stereo amplifier. It had six knobs and four lights on the front. Two cables protruded from the back.

"You know how it works?"

"Not really."

"OK, this is your power cable. This is your I-O cable. It fits on your head like this." As he spoke, Fleem fitted a stethoscope-like device to my temples. "This knob is the theta gain. This one is the z-axis normalization. This is feedback squelch and this one is the volume. The rocker switch on the back turns it off and on. Got all that?"

"What do I do after I turn it on?"

Fleem looked at me as if I had just asked a master watchmaker what the big hand and the little hand were for. "You talk to it, of course. Users!" he muttered darkly.

"What do I talk to it about?"

"Whatever you want to talk about. That's what the Brain Box is for. You talk to it and talks to you."

"If that's all it does, why is it any better than a therapist, or a witch doctor?"

"Because that isn't all it does. While you're talking to it, it reads your mind."

"Excuse me?"

LICENSED TO UNZ.ORG
ELECTRONIC REPRODUCTION PROHIBITED

The Theta Gain Probes—the things on your head—interpret your brain activity and they correlate what they sense with what you say. They read anger, fear, prevarication, and delusion, and they integrate those responses with your conversation. Using this information, the machine adjusts its answers and its questions. The more you use it, the more accurately it learns to respond to your needs."

You mean, that it would eventually become customized to my personality?"

Exactly so! After a few hours, its neural net simulation will be acclimated to your responses and the Brain Box will customize its advice based on that information."

What a wonder! Insight no human therapist could hope to match. The gift of the ages for only $495, batteries not included.

The User's manual was a snap. Plug it in—or use the optional $39.95 battery pack for Therapy-On-The-Go. Adjust the "headphones," turn up the volume and discuss your pressing concerns with your Confidential Advisor. Earphones an optional extra.

I came up with the campaign's tag line that first evening:

Why wait for sanity?"

The advertising copy practically wrote itself!

"Are you plagued by irrational fears? Do perfect strangers look at you oddly? Are your co-workers all against you? Are you lonely? Do you often find yourself suppressing the desire to buy something made out of rubber? All these and many other problems can be treated simply and easily in the privacy of your own home.

"Why wait for sanity?

"Get normal at warp speed with the Confidential Advisor. Preferred terms for government employees. Group discounts available for inmates.

"Using our patent pending speech synthesis technology your Confidential Advisor will talk with you in a human sounding male or female voice. New England, Texas and Mississippi accents available as optional extras. Let the Confidential Advisor help you to sanity. Only $495. Installment payments available. Disturbed personalities our specialty."

And if you think the print campaign was impressive, you should have seen the TV spots. An actor dressed as Sigmund Freud drones to a patient on a couch:

"Now at the end of our 437th session, Mr. Smithers, you were telling me about your feelings when your goldfish died." Suddenly, a lightning bold strikes the floor in front of Dr. Freud and in a flash of light, Confidential Advisor Man appears. He's dressed in an immaculate three piece pinstripe suit. He carries an alligator attaché case.

"This is the twenty-first century, Mr. Smithers," he says to the disconcerted patient. "Don't waste your time and money with these horse and buggy methods. I'll help you get normal at warp speed!" Before the startled patient can say anything, Confidential Advisor Man opens his briefcase and takes out the Classic Advisor Unit. He slips the headphones against

LICENSED TO UNZ.ORG
ELECTRONIC REPRODUCTION PROHIBITED

Smithers's temples, presses the "on," switch and twists the volume dial.

"Go, on Mr. Smithers, tell your Confidential Advisor what's really bothering you." Hesitantly at first, then with growing confidence, Smithers begins talking to the machine. A look of relaxed satisfaction spreads over his face. Confidential Advisor Man turns to the camera.

"Don't let life get you down," he says authoritatively. "For just $495 the Confidential Advisor can make you normal at warp speed!" As we fade out we see Dr. Freud approvingly studying the machine and trying the headset on for size.

Well, the effect of this campaign was startling, I can tell you. Orders poured in. We set up a nationwide distribution network. K-mart was ordering the product by the trainload.

Then Mrs. Thelma Flebitis bought one. I suppose it was inevitable. It had to happen sooner or later. It just turned out to be sooner. Now, the manual was quite clear. It said it right there on page nineteen in ten point type: "For best results, one Confidential Advisor per Advisee." But she didn't read that. No, Mrs. Flebitis couldn't be bothered following the rules. She bought one confidential advisor for her entire family: herself; Willy Ray, who had just gotten out of Juvenile Hall for setting the mailman on fire; Ulla, the fourteen-year-old who had tattooed a likeness of the Abrams A1A tank on her belly; Big Daddy, the author of an unpublished account of the sexual practices of the four alien races he claimed to have studied; and Glimmer Girl, the family's four-year-old Rottweiler.

Well, I ask you, how could one Advisor handle all those troubled souls at the same time? Just interpreting Glimmer Girl's barks and whines was enough to tax its powers. The User's Manual warned them right there on page thirty-two: "Not recommended for pets without the optional 'Pet-Meter' attachment." But did they listen? Did they care?

Within days the machine had suffered a terminal meltdown of its neural net circuits, but not before Willy Ray tried to marry Glimmer Girl, and claiming that Uncle Seth was an outlaw from Alpha Centauri, Big Daddy beaned him with a bowling ball. Personally, I think it was Glimmer Girl who put the poor machine over the edge.

They all sued Xcitement. They claimed that their deviant behavior was caused by the Confidential Advisor. Sheer nonsense, of course, but when did that ever stop a jury? The tabloids had a field day. A terrified populace returned the devices by the trainload. Everyone demanded their money back. Faster than you could say "Bankruptcy Court," Mr. Slumber was in hiding and I was unemployed, again.

But things could be worse. Tomorrow's another day. It's always darkest before the dawn. Everything will be just fine. Why am I so sure? My Confidential Advisor told me so just this morning. And it's never wrong. ■

LICENSED TO UNZ.ORG
ELECTRONIC REPRODUCTION PROHIBITED

Ian Randal Strock

IT'S THE THOUGHT THAT COUNTS

"We're dead. Circulation is down again this year—this is the lowest it's been in five years. If this keeps happening, the publisher's gonna shut us down for sure. How are we gonna get those numbers back up?"

"Clone the readers?"

"Yeah, right. Get cell samples from each one and then implant them in available women, and wait fifteen years for them to start reading the magazine? We'll be out of business before then, if they don't jail us first."

"Well, we've always said that it takes a certain mind-set to read *Stupefying Stories*. What if we simply clone that mind-set?"

"Clone the mind-set?"

"Yeah. The Human Genome Project is finished—we know where all the genes are. Now all we need to do is get a representative sample of readers, figure out which of the gene patterns we want to select for, and then start distributing them."

"How? Free diskettes?"

"Ha ha. No, seriously, we'll use genetic engineering. A retrovirus to modify a few genes should do it."

"Won't people notice, when they start wanting to read *Stupefying Stories* after never having read science fiction before?"

"Sure they would—if we distributed the retrovirus randomly among the population. But that would be bad. We need to target our audience to people who might have picked up *Stupefying Stories* already—push them along in the right direction. And then make sure *Stupefying Stories* is the first science fiction magazine they see. We should seed the retrovirus into schools, specifically, science classes, starting at like high school."

"Is that it? Create the retrovirus, spread it in high schools, and stand back?"

"Well, of course not. Once we've prepared the minds to read *Stupefying Stories*, we have to give them the opportunity to learn that *Stupefying Stories* exists. If we can get one copy into the hands of a student we've prepared to want the magazine, we'll have a lifetime subscriber."

"And that means . . . ?"

"That means we're gonna have to convince the publisher to spend some money on publicity and advertising."

"Like I said, we're dead. The publisher's gonna shut us down for sure." ■

LICENSED TO UNZ.ORG
ELECTRONIC REPRODUCTION PROHIBITED

THE REFERENCE LIBRARY Tom Easton

Mars Underground, William K. Hartmann, TOR, $24.95, 352 pp. (ISBN: 0-312-86342-X).
Secret Realms, Tom Cool, TOR, $?, ? pp. (ISBN: . . .).
The Siege of Eternity, Frederik Pohl, TOR, $22.95, 313 pp. (ISBN: 0-312-86375-6).
The Last Hawk, Catherine Asaro, TOR, $25.95, 447 pp. (ISBN: 0-312-86044-7).
Carlucci's Heart, Richard Paul Russo, Ace, $5.99, 391 pp. (ISBN: 0-441-00485-7).
Alien Influences, Kristine Kathryn Rusch, Bantam, $5.99, 341 pp. (ISBN: 0-553-56998-8).
Driving Blind, Ray Bradbury, Avon, $23, 261 pp. (ISBN: 0-380-97381-2).
Girls for the Slime God, Mike Resnick, ed., Obscura Press (Wunzenzierohs Publishing Co., P. O. Box 1992, Ames, IA 50010-1992). $15 + $2 s&h, 216 pp. (ISBN: 0-9659569-0-3).
The Young Guy from Fuggoth: Eldritch Limericks and Poems, M. M. Moamrath, edited by Joseph F. Pumilia and Bill Wallace, Zadok Allen, Publisher (Darrell Schweitzer, 113 Deepdale Road, Strafford, PA 19087-2627), $5 + $1.50 s&h, 40 pp. (ISBN: none).

There was a time when we all dreamed of a Space Age. The Apollo moon landings would be followed promptly by the construction of space stations, moon bases, and O'Neill habitats. Intrepid adventurers would explore Mars, the Belt, and the outer planets, and then move on to the stars. Behind them would come the entrepreneurs and the settlers. The pace would be fast, and no one involved would have much time for thumb-twiddling.

As it turned out, there was lots of time for thumb-twiddling. We've kept on sending ships to space, but aside from the space shuttle, they've been robots. The men and women who might have gone along have had to stay here on Earth, waiting in university and government labs for the ships to reach their destinations and start sending data home.

What do they do while they're waiting? They don't twiddle their thumbs. Instead, they plan for future missions, hunt for grants, teach, and write sf novels.

Really? Serious scientists scribbling that Buck Rogers stuff? That's what

LICENSED TO UNZ.ORG
ELECTRONIC REPRODUCTION PROHIBITED

William K. Hartmann does with at least part of his waiting time. He's involved in the Global Surveyor mission, reaching Mars hot on the heels of the July 4th Pathfinder bouncedown, and his career reaches back to the Mariner 9 flyby. And writing is not new to him, for he has been responsible for a number of textbooks and popularizations.

For his fiction, here's **Mars Underground**, set well into the next century, when there is a Mars City in place on the Red Planet, occupied by explorers and researchers and administrators, many of them worried about potential funding cuts. Hints of long-past life have been found, and the terraformers are busily melting the icecaps.

Alwyn Stafford is a crusty old fellow who has been responsible for a number of important discoveries; now he is jaunting off into the Hellespontus desert to discover an ancient lander and carefully lay a maze of false trails before vanishing over the horizon. Carter Jahns is one of the administrators, a friend of Stafford's, currently inspecting the Stonehenge takeoff constructed by Philippe Brach, artist in residence. Annie Pohaku is a journalist come all the way from Earth to poke around. The first things she pokes are Carter and Philippe, but before the frolicking can begin, they must be interrupted by the news that Stafford is missing and left word that Carter may be able to find him.

With the aid of orbital surveillance photos Carter indeed finds a trail and a clue that points to where Stafford must be. There is no hint of the reason for his disappearance, but the Astute Reader has read the jacket copy and knows that somewhere in the story is the amazing discovery that humans are not the first sentients to land on Mars. Meanwhile, Annie spends a night with Philippe, Carter gets jealous, Annie says she likes him too, and Hartmann uses the romantic conflict to pace his progress toward his finale.

Hartmann's great strength is his portrayal of Mars, the setting and atmosphere. He's not bad at pacing and he's clever in his alien mystery. Some of the people are nicely done; I liked Stafford, Philippe, and Annie. Some—including Carter—are unconvincing. A few are as thin and clichéd as you have ever seen, but don't let that stop you. The jacket copy compares the book to Arthur C. Clarke's *2001* with some justice (even the faults are shared).

Will there be a sequel? Well, Hartmann installed a very obvious hook to hang one from, so maybe . . .

When David Hartwell sent me Tom Cool's **Secret Realms**, the accompanying note said the novel reminded him "of Roger Zelazny's work, archetypal heroic sf adventure: clever, fast-paced, with serious underpinnings. And we all sure could use another writer like Zelazny."

He may even be right. *Secret Realms* is indeed a crackerjack. At the start, it seems quite cryptic. Characters Trickster, Cat, Snake, Dreamer, and more are being put through exercises that look a lot like video games. Lots of shoot-'em-up-bang-bang and movement to a new level if you survive this one, complicated by the knowledge

LICENSED TO UNZ.ORG
ELECTRONIC REPRODUCTION PROHIBITED

that this is the only world you know, and you may or may not be just a software entity.

Before long, Cool reveals that the characters' world is indeed a cyberworld. The Chinese have hooked infants' brains into a super-computer complex and grown them to maturity in an artificial reality designed to foster the skills of body, mind, and data manipulation essential to modern war. And these fifteen boys and girls are *good*—fast and strong and smart.

Perhaps too smart—for Trickster and Dreamer have intuited the existence of an outside world, a larger world, of which theirs is but a subset or realm (Dreamer thinks the outside world may also be a realm of something larger). And when their masters finally decide it is time to use them in an all-out war against Japan and let them interact with that outer world, they begin to see other options than their masters would like—if they but knew.

Is war really necessary? If you could save millions or billions by sacrificing a few thousand, would you do it? Is such a question as moot as one might think for characters who can falsify orders to send an American aircraft carrier into harm's way, destroy fifty heavily armed Japanese commandos, and . . . ?

Well, they're not invulnerable. But they do have immense powers by ordinary standards, they do make hash of the opposition, and they do it all for a good cause. This makes Cool's yarn a very satisfying adventure.

The trouble with it is that though the technology behind the story seems a fairly reasonable projection of ideas now being developed, it struck me as a little much to have a character's physical and mental speed transfer so neatly from the virtual to the real world, as if physical laws were not pertinent. The overall feel wound up as that of a comic book.

You might even say, a real Cool comic book.

Frederik Pohl's **The Siege of Eternity** is the sequel to *The Other End of Time*, which I called forgettable and pedestrian in March 1997. In it, a suspected alien presence on an abandoned space station drew an expedition in search of alien technology but as soon as they arrived, secret agent Dan Dannerman, astronomer Pat Adcock, and several others were shanghaied across the galaxy, caged, copied, dissected, and so on. Meanwhile, the originals were sent home with bugging devices in their skulls. Eventually, the abductees—or copies of them—returned home.

Copies? Sure. One of the alien technologies is matter transmission, and of course copying is precisely what that permits. As *Eternity* opens, there are two Dannermans and five Adcocks, one of them pregnant. The U.S. National Bureau of Investigation has custody of them and a trio of aliens, the bugs are being puzzled over, the alien technology is being drooled over, and every member of the UN is trying desperately to stake a claim to what all believe must be a colossal treasure hoard.

Unlike many sequels, this one is more successful than its precursor. The leak in the NBI was disappointingly easy to spot, but human foolish-

LICENSED TO UNZ.ORG
ELECTRONIC REPRODUCTION PROHIBITED

ness gets its share of Pohlian pokes along the way to a discovery far too well forecast in the cover blurb: the aliens are already here, infiltrating in surprising places, and Earth has a struggle on its hands if it is not to be swallowed or destroyed. Yet there is a hint of dissension within the alien ranks, and if Dannerman *et al.* can just break through a difficult language barrier there may be hope.

It seems an easy guess that there will be a third entry in the series.

Catherine Asaro's **The Last Hawk** is not quite the usual sort of thing, for it hybridizes sf with romance, turns the mix on its head, and makes it all work quite well. The biggest flaw is the accidental discovery of gunpowder when chemicals mix on a lab bench and produce an explosion despite not being confined (unconfined gunpowder produces a glorious "FOOFF!")

That aside (and who besides *Analog* readers would care?), this one's a winner. Kelric, heir to the interstellar Imperialate of Asaro's previous work, crashes on the Interdicted world of Coba where women rule and men are sex objects whose chief intellectual attainment is the game of Quis that dominates Coban politics. The best male Quis players are kept in harems called calanya, where they use their Quis to advise the managers (once known as Queens) of Coba's ruling estates. It doesn't take long for exotic Kelric to make an impression—Oh! That golden skin! Those eyes! Those muscles! He catches on so fast to Quis! And aw! Our food makes him sick! He wants to go home, but his internal boosters were damaged by the crash and every escape attempt fails, the last one because he is such a noble creature. Soon he is in prison, soon a master of Quis, soon the mate of a besmitten estate manager, soon the center of a web of envy and scheming that actually hands him one grand passion and two kids he is rarely permitted to see.

Eventually, he passes through the harems of half a dozen managers, including two world rulers, and a war is fought over his aging buns. The context is very well developed, and the characters are quite nicely realized. Asaro holds the interest and satisfies, and if a male reader is necessarily a bit bemused by the way so much of the sexism in our world gets turned around (a perfectly valid way to make a point, and bemusement can be an eye-opener), a female reader will be quite charmed.

Richard Paul Russo's **Carlucci's Heart** is a winner. It's set in the same run-down San Francisco as *Carlucci's Edge*, marked by the same empathetic characterization, and—perhaps because the weirder side of the cultural milieu is less prominent here—enough more convincing for me to call it potential award material.

Carlucci is a tough, honest cop who works the boundary between the city and the walled-off Tenderloin with its cesspool Core. He has two grown daughters: Christina is healthy; Caroline has Gould's Syndrome, a neurological breakdown that will kill her before she is thirty.

LICENSED TO UNZ.ORG
ELECTRONIC REPRODUCTION PROHIBITED

The action starts with Caroline. She is visiting Tito, a friend who is dying of AIDS, but Tito is not home. There's only a low-life who is packing Tito's worldly goods into a sack and saying that he was taken away by representatives of Cancer Cell, a mysterious Core-based group with a reputation for human experimentation.

Meet Cage, a street clinic medic. He is trading his services to Cancer Cell for a supply of medicine for the clinic. But one of the Cancer Cell reps is obviously sick.

Here's Tito again, vomiting blood onto the clinic floor, dying. Here's word that the Cancer Cell rep died similarly. Cage's girlfriend begins to show the same symptoms. Carlucci, investigating Tito's abduction, asks a woman questions about Cancer Cell, and she is murdered. Intriguingly, she has connections to the orbiting New Hong Kong, which we met in *Carlucci's Edge* as a hotbed of medical profiteering.

And who is Isabel? A monkey, free in the shadows of the Core, released with others after a spell in some low-gravity place. Do you recall the ebola virus? It came from monkeys and showed symptoms kin to those of Russo's mysterious ailment—call it Core fever—and it didn't take long for me to think that New Hong Kong had released the germ deliberately.

And the disease is spreading. There are no known survivors. There is no treatment. Plague is on the loose.

Caroline infiltrates Cancer Cell in an effort to learn whether there is any connection between the organization and the plague. Cage struggles with the death of his girlfriend and the rise in plague cases. Carlucci hunts a murderer and goes a bit bananas when his daughter disappears.

And then? I won't say who dies, who lives. I won't reveal whether or why New Hong Kong really released the plague, or whether Russo pulls the chestnuts out of the fire before the end. I will say this is a bleak tale very well done. You will care about the people here, and when you set the novel down, you will be angry at the way life has treated them all.

Not at the way Russo has treated them. He's the guilty party, of course, but he convinces you that their fates are as real as your own, and perhaps even that you will share theirs.

Feeling a bit feverish? Got a headache? Bright red rash?

Aw, gee, I'm sorry. But don't get too close. I want to live long enough to read Russo's next.

Kristine Kathryn Rusch's **Alien Influences**, first published in England in 1994, is built around three shorter pieces that appeared in an sf magazine and an anthology, but it does not feel like a fix-up. Rusch tells a unified tale, and she tells it very well. If it still fails to convince, it is more because the reader really does not want to be convinced that adult human beings can be so utterly, utterly stupid.

But ask a kid. Grown-ups *are* stupid. And here is the world of Bountiful, home to the Dancers, aliens who have no past, enjoy strange customs and abilities (including levitation), and grow herbs the human colonists process into Salt Juice, a euphoriant with no admitted addictive power or

LICENSED TO UNZ.ORG
ELECTRONIC REPRODUCTION PROHIBITED

side-effects. Meet the adults, comfy in their Dome hooked on the Juice, and behaving as self-centeredly as any of today's addicts. Meet the kids, neglected and abused, absolutely frantic to escape their Bountiful homes but blocked by a rule that only adults can take ship out of there. When a do-gooder takes them to meet the Dancers they duly note that the aliens help their young grow up by chopping off their hands and removing their hearts and lungs.

Led by John, the kids decide to give it a whack. When the bodies start showing up on doorsteps, the adults go ballistic and immediately blame the natives, even though no Dancers ever get into the Dome. They clamor to exterminate the savages, but they cannot do so without an official imprimatur. They therefore summon Justin Schafer, sure that he will render the decision they wish since he had done so once before. But Justin knows well that he blew it the last time and is resolved to get it right this time. He investigates carefully and finds that the natives are not guilty. The monsters—especially so for their contamination by alien influence—are the colonist's own kids.

One might think that the Powers That Be would show a little understanding, dig out the reasons why, and kick parental butt. But humans feel a bit alone out there among the stars. They're surrounded by aliens, and they feel it a struggle to maintain their humanity. Kids doing alien things—including levitation and losing their eyeballs when they die—for any reason at all scare the socks off those Powers, and it doesn't take long to have the Dancer Eight branded as murderers and shipped off—without trial—to grow up in a penal colony.

Eventually released, most of them find sad niches and die. John is a bounty hunter, and when he is engaged to recover a stolen alien—captured as an art object—his path takes him back to Bountiful and an understanding of what he and his childhood companions were really doing. He even achieves a kind of resolution, though the tale's last few lines promise a hope of happiness that really has very little to do with all that has gone before.

Is that a problem? Well, Rusch is talking about the need, as one grows up, to let go of childish obsessions, and then to move on. Yet when one moves on—to adult love and family—one does so on a base constructed in childhood. If one does not build that base then, one must do so later, at a much greater cost in time and pain. John may have done this, but Rusch's coding is here so opaque that one misses the connection.

There's only a smidgen of sf or fantasy in **Driving Blind**, but since the author is Ray Bradbury, I couldn't avoid it. And I'm glad I didn't. The twenty-one stories here—most of them hitherto unseen—are all of the same distinctive flavor, small-town nostalgia, smooth and slick, clever and warm with an occasional hint of naughtiness, easy to read in a mode that just is not much seen elsewhere.

If you're familiar with Bradbury's work—*Dandelion Wine*, for instance, and who isn't?—you know what I

LICENSED TO UNZ.ORG
ELECTRONIC REPRODUCTION PROHIBITED

mean. If you share his yearning for a simpler time, my description amounts to an endorsement and a recommendation. If you don't, my description is a curse for a man who has not advanced with the times, who indeed has never been able to accept the world as it has been all his life (he assures us in his Afterword that he has never learned to drive) and craves the childhood of his parents and grandparents, of Mark Twain and Booth Tarkington, of porch swings and fireflies, sarsaparilla and buggy whips.

I don't think there's anything between these covers that will live as long or as well as his early work, but there is considerable pleasure to be had, surely enough to satisfy any lover of Bradbury. Among my favorites here is "Madame et Monsieur Shill," in which two beautiful people dine free in a restaurant window to attract customers; when he comes to want her, however, he is no longer beautiful. Another is "That Bird That Comes Out of the Clock," in which a woman steals husbands because she knows both how to play and how to lose.

In his introduction to **Girls for the Slime God**, Mike Resnick informs us that the very first issue of *Playboy* he ever bought (at age 18), contained a send-up of pulp sf magazine covers showing bare-bosomed maidens in the clutches of assorted fiendish BEMs. Most of those covers had little to do with anything inside the mags, but in one case—*Marvel Science Stories*—the relationship was so close, according to Barry Malzberg's afterword, that the U.S. Postal Service told the mag to cease and desist. The risqué stories stopped after issue three. They lasted long enough to inspire Mike, however. One result was a winning masquerade costume and skit (Best in Show, 1979 NorthAmeriCon; script included here).

The other result was this very amusing, very campy anthology. It includes the *Playboy* article, William Knoles's "Girls for the Slime God," three *Marvel* stories (all by Henry Kuttner), and Isaac Asimov's own send-up, "Playboy and the Slime God," which *Playboy* requested and then rejected (it wound up in *Amazing*). The book's 1000-copy run also marks the debut of a new small press which, if it can get more material as appealing as this, is destined for greatness.

For my sins . . . I keep mentioning Darrell Schweitzer's chapbooks of cthulhuianly horrible limericks, and he keeps sending them to me. The latest is **The Young Guy from Fuggoth: Eldritch Limericks and Poems**, by M. M. Moamrath, edited by Joseph F. Pumilia and Bill Wallace, with a mock-scholarly introduction by Lemuel Flagella, SQL, BFD, MSG, editor of *Outgrabe: The International Journal of Moamrath Studies*, who says that Moamrath was "perhaps the worst writer who ever lived."

What Moamrath actually was was a fannish takeoff on H. P. Lovecraft, a send-up, an "Oh-god-start-running-here-comes-another-one" running joke. In other words, good clean fun of the sort that really should be bound in leather and set on the dean's desk just to see whom it would fool. ■

LICENSED TO UNZ.ORG
ELECTRONIC REPRODUCTION PROHIBITED

BRASS TACKS

Dear Mr. Meisner,

Thank you for an excellent article on "Cosmological Darwinism," in the November 1997 *Analog*. As a non-physicist techie, I appreciated the whole discussion, pros and cons.

Perhaps the biggest problem in finding a root cause for the Universe is that we emotionally want there to be a root cause. I certainly don't like the "It's elephants all the way down" kind of explanation.

Even those who bend toward the Deity root cause have a problem, namely, how did the Deity come to be? The "unknowable nature" resolution is one of faith, and for purposes of these kinds of discussions equates to an I-dunno-and-can't-speculate-further worthless answer.

So, what if there is no root cause? Do quantum black holes and wormholes and potential time travel suggest that maybe Smolin's Foundation Universe, by repeated attempts created Progeny that finally procreated the founder?

Yuck. I still want a root cause. The accidental clump of something that aggregated and expanded into space-time. The initial pebble that started the avalanche.

For the layperson, I highly recommend the *Scientific American* web-site's discussion of wormholes and time travel.

RICHARD VIREDAY
richard@vireday.com

Dear Dr. Schmidt

Amen! Your November editorial was almost like a sacred reading. What I don't understand is why most people don't wake up to the facts. Take the example of water conservation. You want people to save water? Tax it. Do we do that? No. We have the Federal government regulate the size of flush toilets we can buy. Does it work? No, it still takes about 5 gallons of flushing to dispose of human waste. If you have one of the 3.5 gallon jobs like I do, you have enough instances of having to trip the lever twice that the average comes to about 5 to 6 gallons to properly dispose of waste. If you have one of the new 1.6 gallon jobs, you are very lucky if it's something less than a four-flusher.

This would be amusing if it weren't for the fact that most people would rather not spend their free time watching toilets in action. And, more importantly, it's a symptom of a federal government philosophy that says it has the right to control very minute aspects of your life. I'm not a Libertarian yet. But they are right. There is a large part of the government that need disinventing.

LICENSED TO UNZ.ORG
ELECTRONIC REPRODUCTION PROHIBITED

If you want people to use air bags give them an incentive. If they really work, the insurance companies should reflect this value in reduced premiums. Personally, I don't particularly like the idea of riding around with a few ounces of high explosives sitting in front of my face. I would gladly pay extra insurance premiums for the privilege of driving without a bomb, cocked and ready, in my steering wheel. As you pointed out, it should be my choice. I should be able to have the explosives removed, without having to roll the car downhill into a tree.

I loved Mark Rich's Sufficiently Un-Advanced doorknob. And as for Arlan Andrews' story on the breakup of Ma Bell, you ain't seen nothin' yet. Wait until deregulation of the power companies hits. The reliable service people take for granted today will be a memory when price-only begins to rule the market. If you write on a word processor, you might want to set your saves to something faster that one per minute. Brownouts and rolling blackouts will be more common than thunderstorms. Then, when it becomesbad enough to do require intervention, I suspect you will be offered a reliable service at an increased rate. Want to bet that the increased rate will be more than you are paying now in the regulated environment? Is anything that was deregulated still a better buy now than when it was controlled?

Keep up the good work.

PAUL BRUCE
SOUTH HAVEN, MI

Dear *Analog*,

I was somewhat confused by Dr. Schmidt's editorial in the November '97 issue. Then I read "WWW: The Web We Wove" and all became clear. We're getting our history from different universes!

The editorial says "The assumption that air bags save lives depends on their being used with seat belts. . . ."

Oh, really? In my universe, the rationale given for requiring air bags was that they would save the lives of those too stupid or too pigheaded to wear seat belts. This premise has since been supported by at least one study which concluded that while either seat belts or air bags decreased serious injuries and deaths by about the same amount, the incremental value of an air bag to someone wearing a seat belt was quite small.

I also doubt that the welfare of the pigheaded/stupid was the actual impetus for air bags, but rather the profits of the corporations which insured them. Perhaps there is an alternate universe where corporations are as altruistic as individuals can be? Fat chance!

As far as the risk/responsibility/ lawsuit portion of the editorial, I quite agree. As an ex-smoker and a motorcycle rider, I can assure you that my insurance rates reflect any additional risks (or the industry needs new actuaries!). The state expense is therefore limited to those without insurance. In the case of smokers, that would appear to be taken care of by the taxes they pay. For motorcyclists, my license endorsement for motorcycles doubles my cost over a non-motorcyclist.

Keep up the good work. I've been reading *Analog* for about 30 years

LICENSED TO UNZ.ORG
ELECTRONIC REPRODUCTION PROHIBITED

now and hope to continue for the rest of my life.

LARRY BLANCHARD
OTIS ORCHARDS, WA

Dear Dr. Schmidt,

This letter will be short, even if not sweet. On page 10 of the November '97 *Analog*, second column, the text reads "... if a car owner would rather choose a different set of risks, why shouldn't they be able . . ."

When in hell did the rules of grammar change? I'd accept ". . . why shouldn't he . . ." or ". . . why shouldn't she . . ," but ". . . they . . . ?" Come off it, Schmidt! P.C. may be OK for the pusillanimous hoi polloi, but . . . the editor of *Analog*?

As a reader since the middle 1930's, I'm ashamed of you. John Campbell would have disowned you!

SHELDON STEUER

Actually, the rules of grammar have been changing continuously through the entire life of the language (as John W. Campbell knew perfectly well). On this particular point, they're definitely in a state of flux. As you should know if you've been reading me at all regularly, I have absolutely no interest in political correctness. You might also remember that I've commented at length on this particular problem in my editorial "Tools of the Trade" (June 1989), which I modestly suggest you reread.

The intervening 8 years have made it clear that the genderless/general "he" is no longer anywhere near as generally accepted as it once was, and that our culture is in the process of trying to agree on a substitute (which textbooks will recognize only after it's happened). The singular/general "they" is one of the increasingly accepted contenders. Personally, I monitor the situation by periodically using most of the candidates to see what kind of reaction, if any, they get. So far yours is the only complaint I've had about this particular use of "they." Like you, I'm not particularly fond of it, especially since, as a Swahili speaker, I know how much better it can be done. But it may be the best we're going to do in the realistic near future.

Stanley Schmidt

Dear Stan:

I've been a subscriber for many years and finally I have a question. What was "No More to the Dance" by Amy Bechtel doing in the November issue of *Analog*? I have always enjoyed greatly the selections in the magazine, but over the last months/years I have begun to notice a disturbing trend. There seems to be more and more of what I would normally expect to find in *Good Housekeeping* or *Better Homes and Gardens* or perhaps *True Confessions* showing up in *Analog* with the Science Fiction and Fact.

Don't get me wrong, I read the story and it was a good story. It was not what I have come to expect or look for in *Analog*. As the title of the magazine states, *Analog, Science Fiction and Fact* is what I am looking for and I found neither in the above mentioned novelette. It was, however,

LICENSED TO UNZ.ORG
ELECTRONIC REPRODUCTION PROHIBITED

good fiction and should find itself being published elsewhere.

Trial by Ordeal, by Grey Rollins, on the other hand, *is* the type of thought-provoking, speculative, mind-expanding science fiction I, and other *Analog* readers, have come to enjoy, appreciate and look forward to in each issue.

JOHNNY L. KNIGHT

Good Housekeeping *or* True Confessions*? Surely you jest! "Thought-provoking, speculative, mind-expanding science fiction" is about how possible developments in science or technology might affect the lives of people, and "No More to the Dance" is certainly that.*

Stanley Schmidt

Dear Dr. Schmidt:

In your October editorial "Prophetic Deja Vu," you are tolerantly amused by the reactions of the media and the general public to the news of Dolly's cloning, suggesting that they have not been paying attention to what we science fiction readers have been thinking about for decades. Yet later, you footnote that the technical term *clone*, meaning "the sheaf of genetically-identical individuals produced by an episode of asexual reproduction," has taken the general usage of a clone, meaning "one such individual."

That sort of linguistic evolution could not have taken place, I think, if stories about cloning had remained solely within the SF ghetto. Perhaps the general public is hipper than both you and the media think, and it's primarily the self-styled pundits who have deprived themselves by disparaging fiction—and particularly genre fiction, and most particularly our genre—as a source of ideas for serious discussion.

You also say that ". . . those 'badly done' stories . . . often have plots hinging on whether somebody is a 'real person' or a clone. A clone of a person is a real person . . . ." This could be taken to suggest that that the question, "clone = real person?" has been settled definitively, and that therefore stories based on the question are intrinsically flawed. But I don't think it has been settled. What *is* a "real person?"

Step outside the question of genetics and consider the notion of the Bend Sinister. Is it possible, by medical examination, to determine whether an individual is a bastard or not? Of course not . . . because bastardy is a social attribute, not a genetic one. Yet its application—often regardless of the truth of the matter—has bent the lives of persons and nations.

Is Heinlein's *Friday* a poor story because Friday believes herself to be less than a 'real person' for being a genetic construct rather than a product of the marriage bed? (And this despite her "father's" certainty that the notion is superstitious bigotry.) No. You may criticize the story on other points, if you like, but not on that one. It is a valid moral question.

And that is my point. To ask whether clones (or bastards) should be treated with the same respect as persons born "naturally" of socially-licensed parents is a valid, and important, matter for debate. (Personally, I

LICENSED TO UNZ.ORG
ELECTRONIC REPRODUCTION PROHIBITED

vote with Spider Robinson: anyone who says "excuse me" is a human being in my book.) To assume that clones will be treated with respect strikes me as naive.

Not that you do, or you wouldn't have written the editorial.

DAVIDSON CORRY
davidsco@attachmate.com

Dear Stan:

I am afraid that I must (partially?) disagree with your remarks about human cloning in your October editorial. I believe sober, rational consideration indicates that humans will not be cloned in the foreseeable future.

Of course, that phrase "the foreseeable future" implies about a 50-year time frame. If we go out a century or more we can expect society to have changed greatly. Reasons for human cloning that make no sense today might be perfectly sensible then. Or maybe we will all be so rich that a half million-dollar price tag* will seem trivial, and the procedure will be carried out for trivial reasons.

In your editorial, you say, "A few of the many reasons people have already thought of (for cloning humans) include providing organ donors, slave laborers, family heirs, or genetic immortality." Let's look at the first two in a bit more detail. Both, of course, necessarily involve denying the clones' personhood. Despite humankind's long and shameful record of denying people's personhood in order to exploit them, I do not see this occurring in today's society or any I would consider plausible within my lifetime.

But perhaps even more to the point is that, in both cases, cloning is a terribly inefficient way to accomplish the supposed goal. If you want slaves, surely you gain more by denying the personhood of adults who can be put to work immediately rather than that of babies who must be raised for years before they become useful. Similarly, a clone intended for use as an organ donor must be created 10 or 12 years before the organ is needed. Since needs for an organ donor are usually unpredictable, this creates obvious problems: You'll find yourself raising spares that may never be needed. Yet there is an even stronger argument against clones as spare parts donors: As you are probably aware, tremendous leaps are being made in modifying animal organs for transplantation into humans. There is also major progress in tissue engineering, which will allow simple organs—skin, bone, liver—to be grown in tissue culture. I would strongly predict that either animal organs or vat-grown organs (probably both) will be available long before a human clone could be created and grown as a source of spare parts. And once these organs are available, will anyone even think of humans as a possible source?

Perhaps you are suggesting that, since it is possible—even probable—that humans will eventually be cloned, it is not too early to start discussing the ethical issues. I think it is. For us to give our great-grandchildren ethical advice on human cloning would be like our own great-grandparents giving us ethical advice on, let's say, chicken farming. We would

LICENSED TO UNZ.ORG
ELECTRONIC REPRODUCTION PROHIBITED

probably hear talk about scattering the grain at a given time every day and using the ax skillfully, so as to avoid unnecessary pain. They could not possibly have foreseen factory farming, where most of today's ethical questions lie. Could we do better? I doubt it.

I certainly do not deny that today's SF fans understand cloning and its consequences better because they have read stories about it. Quite the contrary. At cons, I have consistently found that fans realize human cloning is not going to happen any time soon. By contrast, several science writers on the nasw-talk Internet mailing list were adamantly convinced that near-future cloning was a possibility demanding immediate action. The difference, it seemed to me, was that SF fans had experience dealing with contrary-to-fact postulates, and thus were able to judge which represented truly plausible extrapolations and which required a suspension of disbelief. Science writers, on the other hand, were used to dealing with today and tomorrow. Something that might or might not happen a century from now was largely outside their frame of reference.

Of course, none of this speaks to the validity of cloning—even near-future cloning—as a theme for SF stories. Cloning can make for a rousing adventure story, in which the death of one protagonist leads to his or her replacement by a truly close relative. And cloning can provide a perfect setting for exploring questions of nature vs. nurture (as I understand Mike Resnick is doing in his *Widowmaker* series). Writers can also use denial of a clone's personhood as a way to explore the consequences of such denial for both the individual and society. In other words, cloning, like alien races, provides an excellent metaphor for exploring interesting and important issues. But actual human cloning is not one of them.

W.A. THOMASSON, PHD

* In vitro fertilization (a fully developed, routine procedure) today costs $20,000 to $50,000 and shows no sign of getting any cheaper. Since cloning is at least 10 times as complicated, it seems reasonable to assume that it will cost 10 times as much after all development costs have been paid and the learning curve has plateaued.

Dear Stan,

Just read your editorial in the October '97 issue. I think that when you quote Ian Wilmut (". . . Why would you make another human being?"), you're answering the wrong question. The better question is: "Why would you make another human being using this technology, when there is another way that is so much more efficient, cost-effective and FUN?!"

HOWARD MARK ■

LICENSED TO UNZ.ORG
ELECTRONIC REPRODUCTION PROHIBITED

CLASSIFIED MARKETPLACE

ANALOG/ASIMOV'S combination CLASSIFIED AD rate is $4.80 per word—payable in advance ($72.00 minimum). Capitalized words 60¢ per word additional. To be included in the next issue, please send order and remittance to Dell Magazines, 1270 Avenue of the Americas, New York, New York 10020, Attn: Carole Dixon

ASTROLOGY

WITCHCRAFT! Harness its power! Free Protective Pentacle. Write: School, PO Box 297AN, Hinton, WV 25951.

BOOKS & PERIODICALS

FREE LISTS. Quality used paperbacks: SF, mysteries, gothics, westerns. (Please specify) Steve Lewis, 62 Chestnut, Newington, CT 06111.

OBSERVE GALAXIES, planets, double stars or make a telescope using only household materials. Astronomy Book, $9.95. Rogers, 1753 Fisher Ridge Rd, Horse Cave, KY 42749.

EMPLOYMENT

Perl & C programmers: Want to telecommute? http://www.rabidwonbat.com/

GAMES

GAMES BY E-MAIL/FAX! Play Zombie Zone USA by e-mail or fax. Humorous horror game. Play daily or weekly, from home or office. $1 per turn! Call faxline at 800-748-0281. Web site at http://www.faxattax.com

PATENTING

FREE Intervention Kit: Patent and Market your new product idea! Call Concept Network 1-800-846-8368.

YOU'LL MAKE MONEY
SAVE MONEY TOO
by READING and ANSWERING THESE CLASSIFIED ADS

PRINTED WITH SOY INK

PUBLISHING

NEW AUTHORS
PUBLISH YOUR WORK
ALL SUBJECTS CONSIDERED
Fiction, Biography, Religious, Poetry, Children's
AUTHORS WORLDWIDE INVITED.
WRITE OR SEND YOUR MANUSCRIPT TO
MINERVA PRESS
2 OLD BROMPTON ROAD, LONDON SW7 3DQ, ENGLAND

IN THE FUTURE

Your CLASSIFIED/ DISPLAY AD Can Be Placed

HERE!

for details—
CAROLE DIXON
DELL MAGAZINES
1270 AVENUE OF THE AMERICAS
NEW YORK, NEW YORK 10020
(212) 698-1313
Fax: (212) 698-1198

LICENSED TO UNZ.ORG
ELECTRONIC REPRODUCTION PROHIBITED

UPCOMING EVENTS Anthony Lewis

9-12 April 1997
NORWESCON 21 (Seattle area SF conference) at Red Lion SeaTac, Seattle, WA. Guest of Honor—Neil Gaiman. Info: Norwescon, Box 24207, Seattle. WA 98124. URL: http://www.webwitch.com/norwescon.html.

10-12 April 1997
BALTICON 32 (Baltimore area SF conference) at Omni Inner Harbor Hotel, Baltimore, Md. Guest of Honor—Harry Turtledove; Artist Guest of Honor—Jody Lee; Science Guest of Honor—Dr. Yoji Kondo; Registration—$40 until 14 March 1998, $45 at the door. Info: Balticon 32, Box 686, Baltimore, MD 21203; (410) 563-2737; e-mail: bsfs@access.digex.net; URL: http://www.balticon.org.

10-12 April 1997
MINICON 33 (twin cities area SF conference) at Radisson South, Minneapolis, MN. Fan Guest of Honor—Dave Langford; Publishing Guest of Honor—Gardner Dozois; TM—John M. Ford. Registration—$35 until 1 March 1998, more at the door. Info: Minicon 33, Box 8297, Lake Street Station, Minneapolis, MN 55408; e-mail: info@minicon33.mnstf.org; URL: http://www.mnstf.org/minicon33.

24-26 April 1998
PARTHECON 26 (formerly Kubla Khan, Nashville area SF conference) at Nashville, TN. Registration—$25 until 15 March 1998, $30 thereafter. Info: Parthecon 26, c/o Barbara Harmon, Box 90962, Nashville, TN 37209; URL: http://poseidon.tnstate.edu/parthecon/.

5-9 August 1998
BUCCONEER (56th World Science Fiction Convention) at Baltimore Convention Center and nearby hotels, Baltimore, MD. Guests of Honor—C. J. Cherryh, Milton A. Rothman, Stanley Schmidt, and Michael Whelan; TM—Charles Sheffield. Registration until 15 June 1998—$130 (£94); supporting: $30 (£22); children +4 to 12: $65 (£47), children 0.75 to 4.0: FREE (all ages as of 5 August 1998). (These are the latest posted rates as of the time this column went to press.) This is the SF universe's annual get-together. Professionals and readers from all over the world will be in attendance. Talks, panels, films, fancy dress competition, the works. Info: Bucconeer, Post Office Box 314, Annapolis Junction, MD 20701; e-mail: bucconeer@bucconeer.worldcon.org; Web page: http://www.bucconeer.worldcon.org. ■

LICENSED TO UNZ.ORG
ELECTRONIC REPRODUCTION PROHIBITED

Get Twice the Science Fiction Entertainment!

Subscribe to *both* **Asimov's Science Fiction** and **Analog Science Fiction and Fact** and ***save more than 25%*** off the regular price!

You'll get a total of 24 issues (12 issues of each) for only $49.97. You save $18.00!

Each issue of **Asimov's Science Fiction** blends scientific realism with fantasy. Each spellbinding issue of **Analog Science Fiction and Fact** will take you on a journey into intergalactic adventures. Both magazines feature some of the most creative Science Fiction writers of our time.

Call today to begin your subscriptions to Asimov's and Analog at this special low rate.

Mail to:

ASIMOV'S & ANALOG
P.O. Box 54625
Boulder, CO 80322-4625

CALL NOW

To charge your order by phone call, toll-free

1-800-333-4108

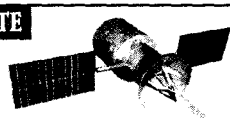
Outside the USA: 303-678-0439

If you already subscribe, you can still take advantage of this special low price. Be sure to mention you're currently a subscriber when you order.

Please allow 6 to 8 weeks for delivery of the first issue. We publish a double issue of each magazine which counts as two issues toward your subscription. Outside USA: Add $16 per year for shipping and handling (U.S. funds only, payable with order). HF975

LICENSED TO UNZ.ORG
ELECTRONIC REPRODUCTION PROHIBITED

TECHNOLOGY UPDATE



"My TV reception is so clear, you'd think I had a 50-foot antenna on my roof!"

Emerson's ingenious new antennas are hard to spot, easy to install and provide clear, powerful reception of broadcast signals...without rabbit ears.

Replace your unsightly "rabbit ears" and bulky antennas now!

I'm amazed at the way technology has improved television. But a television's picture is only as good as the broadcast it's receiving. Rabbit-ear antennas don't improve your picture to any great degree, and most roof antennas are large and not pleasing to the eye.

Stealth antenna. In the past, creating an antenna with optimal reception meant making it big, with a large amount of surface area. This resulted in products that were large and unsightly or small and ineffective. Either way, the aesthetic look of your room or house suffered.

Recently, a scientist in Colorado developed an antenna that would maximize reception without being overly conspicuous. Emerson, a leader in electronic technology, has now made this innovation available to the public. First, they created a flexible circuit board with a serpentine antenna, resulting in a large surface area confined to a small space. Second, they developed a technique that converts the copper shielding on the attached cable to an additional signal receiver, which results in an antenna almost 10 feet long. This greatly enhances the antenna's reception power and allows you to tune the antenna by simply moving the cable! Plus, the omni-directional design allows you to mount the unit anywhere you please. The Optima's universal design makes it adaptable to any component, and installation is a snap.

Mini-dish owners. If you own a mini-dish satellite system, you can pick up local broadcasts with the Dishmate™. It uses the same technological innovations as the Optima TV antenna.

Risk-free. Each of these antennas come with a 90-day manufacturer's limited warranty and Comtrad's risk-free home trial. Try them, and if you're not satisfied, return them within 90 days for a full refund.

Indoor/Outdoor Antenna . . . . . **$69.95** $8 S&H

Dishmate™ UHF/VHF Antenna . **$69.95** $8 S&H

The Dishmate™ will work with 18" dishes from RCA, Toshiba, ProScan, GE, Eurosat, Uniden, and Hughes DSS™ Satellite systems.

Please mention promotional code **2832-12509.**

For fastest service, call toll-free 24 hours day

800-992-2966

DISCOVER NOVUS VISA MasterCard AMERICAN EXPRESS Cards

comtrad industries

2820 Waterford Lake Drive, Suite 102 Midlothian, VA 23113

LICENSED TO UNZ.ORG
ELECTRONIC REPRODUCTION PROHIBITED